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Improving the performance of rescue craft used for rescue and recovery in support of the oil and gas industry

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Health and Safety Executive 2005

RESEARCH REPORT 371

Improving the performance of rescue craft used for rescue and recovery in support of the oil and gas industry

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This report looks at the current situation in regard to the operation of the FRCs carried on standby vessels used in the British sector of the North Sea offshore oil operations and recommends ways in which these operations can be made more effective and safe. It covers the launch and recovery systems used for the FRCs as well as the FRCs themselves. In addition to studying the current operations in the British sector, the operations in both the Dutch, Danish and Norwegian sectors were studied. The report also looks at the training and other aspects of operating FRCs and it produces a series of recommendations to improve not only the conditions in which the FRCs can operate but the make these operations safer for the crews involved.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

HSE BOOKS

First published 2005

ISBN 0 7176 6148 2

EXECUTIVE SUMMARY

This report stems from a study of the current practices for the launch and recovery of the FRCs used in the North Sea offshore oil operations. These showed a general consensus in the way that launch and recovery operations were carried out and in the way that the FRCs were operated but also showed that significant improvements in safety and effectiveness could be achieved by relatively small modifications. These particularly apply to the material and positioning of the painter line, the hook-on and release system for the hoist wire and the layout of the FRCs themselves. The thrust of these modifications is to create a better working environment for the crews of the FRCs so that they can operate more effectively and with reduced risk.

It is felt that some current methods of hook-on and release present significant risks to the crews and these are identified. Improved methods are shown. Changes to the painter line could reduce the risk of the FRC jerking when it is alongside creating a safer environment for hooking on and releasing the hoist wire. As far as the FRC is concerned the proposals seek to remove or modify sharp edges, to provide a secure location for the crew and to make the motion of the boat more comfortable and less stressful.

The report goes on to look at other parameters that can affect crew performance such as the protective clothing, the standardisation of components, crew training and practice. It looks at the possibilities of regulation for improvements to standards but suggest that a voluntary system is likely to produce better results.

CONTENTS

1. INTRODUCTION

The concept of stand-by vessels and their associated FRCs has been around since the first disasters occurred in the North Sea. Because these vessels did not contribute to the profitability of the oil operations, they were considered to be a necessary evil and they tended to be provided at the minimum cost. There was a considerable lack of experience in launch and recovery at sea and this combination lead to the use of FRCs and launch and recovery systems that worked but which did not operate at the best level of efficiency. In trying to provide an acceptable level of safety for the rig and platform crews, some of the stand-by vessel systems put the crews of these stand-by vessels at risk in any rescue operation.

This report looks at the current practice and proposes ways in which changes can be made to upgrade the FRCs and their launch and recovery systems. The primary reason for the proposed changes is improving the safety for the FRC crews but secondary to this will come improved efficiency by extending the operational capability of the FRCs

2. METHODOLOGY

In order to get as wide a view as possible of the equipment and the operation of FRCs used in the North Sea oil operations we have talked to operators and looked at systems in the UK, Holland, Denmark and Norway. Most of the davit and FRC manufacturers have been visited as have training establishments involved in training the crews for FRCs. Whilst this report is not specifically aimed at the operation of daughter craft, we have looked at these operations in order to get a wider view of launch and recovery techniques.

Because there might be relevant technology and techniques used by operators outside the offshore oil industry we have also visited organisations such as lifeboat services and coastguards. To gauge the influence of legislation on the systems is use we have also been in contact with organisations such as the MCA and IMO. Of particular interest here were the requirements for RoRo passenger ships (known as FRB in the marine industry) where there have been serious accidents during training in launch and recovery.

The aim of our research has been to gain as wide an experience as possible in the hope that there can be a cross-fertilisation of ideas between different users and to see the effects of different levels of legislation on the effectiveness of FRC operations

3. LEGISLATION

The legislation covering the installation and design of FRCs varies from country to country with UK operators having a greater freedom in the design and operation of FRC as compared to Norway. In Norway the FRCs are not allowed exposed propellers and there are other criteria that has lead to the development of the diesel/water jet style of FRC. In the UK sector there is greater freedom about the powering and design of the FRC and as far as can be determined, there are no actual specifications for an FRC and its launch and recovery system. Danish operators seem to enjoy a similar freedom and indeed design and build their own concept of FRC.

There is legislation that covers the design and use of FRCs that has been developed under SOLAS requirements. These FRCs are a requirement on passenger RoRo ships and the specification that has been developed could serve as a future pattern for the FRCs used offshore except that the speed requirement under SOLAS is 20 knots, which is considered too slow for offshore oil work. Speed will be discussed in a later section of this report.

Existing standby vessels in the UK sector are fitted with FRCs which are not approved as rescue boats but have been accepted by the MCA as an equivalent on the UK Continental Shelf. Approved rescue boats that are required to be carried on vessels of stand-by ship size are what are called the man overboard boats (MOB) or DOTI boats and are small, underpowered craft deployed by hand operated davits. These MOBs were not perceived as reliable. All stand-by vessel operators asked for exemptions from fitting such DOTI boats and to use their FRC as an equivalent arrangement. In order to ensure continued availability of the FRC for ship's use one of the requirements of this exemption was that there be two FRCs on board with one available at all times for the ship to serve as the MOB. This offered the benefit of temporary redundancy in the event of an FRC failure.

Daughter craft (DC) are over 8.5 metres in length and therefore cannot be considered as rescue boats under SOLAS which puts an upper size limit on FRCs. The MCA has however considered each design on a case by case basis and issued letters to the manufacturers accepting them as rescue boats. This can be important as some vessels have one FRC and two DC. To summarise they are not approved, only accepted, a compromise that offers a pragmatic solution in a situation where the FRC or daughter boat would prove to be a much more effective MOB boat than that specified by the legislation.

Daughter craft are not considered as part of the LSA of the vessel and as such are a vessel that proceeds to sea on its own and so requires a load line or load line exemption certificate. Exemption certificates were traditionally issued to vessels that did not normally go to sea but needed to move from one port to another e.g. a barge or an inshore tug. The exemption certificate contained conditions that did not relate to the structural strength or watertight integrity of the vessel but were important for the vessel's safety e.g. weather limits, contingency plans, cargo limits and whether vessel is manned during the passage. Offshore daughter craft had similar such limits e.g. 10 miles from parent vessel and a 3.5 metres significant wave height limit for normal operations.

From the third edition of the standby code of Nov 2001 all new standby vessels are required to fit fully approved Fast Rescue Boats (FRB) and davits. The SOLAS requirements are taken as the basis for this approval but the davits should be able to hoist at 1.0 metres/second which is faster than the SOLAS requirement. SOLAS davits require stored power availability to enable the FRC to be launched when ship's power is not available but this is not specified for stand-by vessel use. These requirements only apply to the relatively limited number of new stand-by vessels although this number is now growing.

There is a thriving market in second-hand FRCs, daughter craft and davits for existing vessels. If a foreign flag standby vessel e.g. a Norwegian vessel finishes its contract in Norway and comes to the UK it can still be treated as an existing vessel even though it is new to the UK sector and so does not qualify as a new vessel.

There are no regulations for the design, construction or maintenance of FRCs and their davits that were in use before the new code was introduced. All operators however regard them as LSA equipment for maintenance and testing purposes. Load testing is done every five years as if they were LSA equipment and the MCA has said that it would like to see all davit winches overhauled at the same five year intervals.

In the offshore oil industry there is a strong sense of wanting to comply and improve. This is very different to the general shipping industry where the attitude is that if the equipment is approved then the ship owner will to go for the cheapest equipment available and there is little interest in whether it works satisfactorily. In the offshore oil industry we have found that the oil companies or operators who are the duty holders not only want to meet the laid down requirements but increasingly want equipment that works. Generally the quality of a stand-by vessel is carefully scrutinised before they are taken on charter. Once on charter the stand-by vessel operator is keen to maintain effectiveness otherwise the vessel comes off charter. So the industry is to a large degree self-regulating because it is in every party's interest to keep the vessels operational. The only downside to this arrangement is that it can restrict training because this might entail a risk of damage to the equipment resulting in the vessel coming off-hire

4. CURRENT PRACTICE

The FRC and its launch and recovery systems have evolved from very basic early systems into quite sophisticated installations. The FRCs used initially were basic RIBs with a single outboard and were little more that the type of boarding or jolly boat that was found on tugs and similar craft. The launch and recovery systems tended to be either deck cranes or simple swinging arm, hand operated davits. These were often located too far forward for effective launch and recovery and it was apparent that this equipment was on board because of a requirement from the operators rather than to provide an effective rescue unit.

Today we see a significant change in equipment, mainly because the equipment is now required to demonstrate its capability. However, relicts of the historical systems still remain in the form of 4-point lifting slings and lack of any steadying system for controlling the movement of the FRC during launch and recovery. On stand-by ships where the role of the FRC is only to meet the requirement to have a fast rescue boat close to a rig or platform for emergency rescue there has not been a strong incentive to make significant improvements to the concept. This contrasts with the role of the daughter craft where sophisticated boat designs have been developed and complex davit systems are used. It is suggested that these have been developed because using a daughter craft can bring significant cost savings to the operator provided he can demonstrate that the corporate rescue & recovery performance standards can be met. Some of these daughter craft are also used for routine work of personnel and stores transfer which gives another strong incentive to make them work effectively. In the Danish sector the stand-by vessels stay on station and crew changes are effected by ship, a system that gives strong incentive to operate the FRCs in adverse condition so that crew transfer can take place.

In order to propose improvements to the systems and equipment that are currently in use, the following section gives a broad view of current practice.

4.1 FAST RESCUE CRAFT (FRCs)

Rigid Inflatable Boats (RIBs) are in use almost exclusively on stand-by and multi-purpose vessels and most of the fast rescue craft currently in use are based on standard RIBs supplied by a variety of manufacturers. In turn these standard designs tend to be based around the SOLAS approved designs developed by these manufacturers. A notable exception is Esvagt in Denmark who has designed and built boats to their own design and are currently developing a new and improved design. North Star in Aberdeen takes a basic RIB from a builder and then fits this out to their own requirements. These requirements have been developed from experience but closely approximate to the SOLAS FRC requirements.

There are no specific standards laid down for the FRCs used on stand by vessels, hence the use of SOLAS standards that provide a viable yardstick whilst at the same time allowing modifications to facilitate the safe and practical operation of these craft in the offshore environment. In this respect the lack of any requirement for SOLAS approval is a bonus because it does allow modifications to the FRC to be made without the requirement of going through a full approval programme again.

There are three different approaches to powering these FRCs.

(a) Twin outboard motors of 60 or 75 hp using petrol as a fuel. The benefit of using these outboards is that it is relatively simple to replace a unit in the event of an engine failure so that the FRC can be kept operational but the fuel is not compatible with that of the mother ship and has to be stowed on deck.

(b) Twin outboard diesel motors of 35 hp. These are the largest diesel outboards currently available and the installation allows for easy replacement of a failed unit and fuel compatibility with the mother ship but the power available is on the low side for efficient and safe operation of the FRC particularly in the loaded condition.

(c) A single inboard diesel of between 150 and 200 hp coupled to a water jet propulsor where the fuel is also compatible with that of the mother ship and there are no exposed propellers.

In Norway and Denmark propeller protection is a requirement to prevent or at least reduce the risk of injury to casualties in the water. This is why water jet propulsion is used almost exclusively in Norway and many of the Danish boats have propeller guards fitted. The latter reduce the performance of an outboard considerably and the current design of propeller guards will not operate at speeds over 20 knots.

Most of the FRCs have the steering console aft of amidships although on some designs it does extend further forward. The aft location does allow clear space for survivors or cargo in the fore part of the boat. Saddle seating is commonly used as secure seating for the crew and this tends to locate the crew one behind the other in the boat. There is a wide disparity about the provision of handholds for safe movement about the boat ranging from stainless steel handholds attached to the console and the seat backs through to full length central handholds along the centre of the boat forward. In general there is limited provision of security for the crew members who are handling the bow rope and the hook-on system.

As a general rule, those FRCs with outboard propulsion use inflatable tubes whilst those with diesel inboard engines use foam tubes. This division also tends to reflect the difference between British and Scandinavian designs but there is no clear reason for this division other than historical. The benefits of the different tube materials will be considered later.

The bow rope or painter, where it is used, is generally attached to a short strop fitted with a hook with the inboard end of this strop attached to the deck of the boat. The strop is connected to the bow or boat rope with a snap hook, making it easy to connect but less easy to disconnect. The bow rope is usually a polypropylene rope that runs forward to a fixed point on the mother ship.

4.2 HOOK-ON SYSTEMS

There is no consensus about the hook-on systems and it appears the operators tend to use the system that they have inherited from earlier use or when a ship or boat was purchased second-hand or they use the system that has been recommended by the boat and/or manufacturer. There are three main systems in use in the North Sea which are:-

(a) Flexible slings. These are 3 or 4 webbing straps attached to fixed points inside the boat and connecting centrally to a ring that acts as the connection with the lifting wire. This system requires two hands to operate it, one to lift the ring and one to hold the hook, leaving the person doing the job without a hand to hold on with. Releasing the hook on launching can be more difficult as the tongue of the hook has to be lifted first before the webbing strop ring can be lifted out. The webbing straps also restrict the space available inside the boat for survivors particularly injured survivors who have to lie flat and they present a risk of injury when they snap tight on lifting. They also lie in the bottom of the boat when not in use creating an additional trip hazard for the crew.

(b) A fixed pole with the hook-on ring in the top, located at the centre of gravity of the boat. This can make the hook-on procedure a one handed job with the lower part of the pole itself providing a handhold. A snap hook is used for this system but a refinement of the snap hook is the attachment of handles to the two components of the hook so that it can be released one-handed with the hands remote from the actual hook on position.

(c) A central A-frame platform at the centre of gravity of the boat with a patented hook release system mounted on its top. This hook system allows an automatic offload release to simplify launching whilst for hooking on the davit lifting ring has to be inserted into the hook, which can be a one handed operation but is more likely to be two-handed. The hook has to be preset for the different modes of operation.

4.3 DAVITS

Early stand-by vessels that were converted from fishing vessels used the derricks as the lifting and launching system for the FRCs. Even on these vessels, they have largely been replaced by either davits or cranes, the cranes being used on that vessel with the wheelhouse set well aft where there is not room for davits above the superstructure.

Specially designed davits, usually of the G-type design, are now in common use. Alternatives are the pivoting L-shaped davit and the horizontal slewing davit. These all perform in much the same way by transferring the FRC from its inboard stowage to an outboard position above the ship's side from where it can be lowered. The davits tend to differ in the way they operate by incorporating stabilising hooks that engage with the FRC during the early stages of launch or the late stages of recovery. The FRC can be stabilised against the ship's side during the hoisting and lowering operation but these hooks help to stabilise the FRC during its transfer to and from its stowage in the davit. Not all systems have this hook stabilisation and this can leave the FRC vulnerable to damage during this part of the operation.

Stabilising systems will be discussed later in this report but they are considered an essential part of the davit design. An alternative system is seen where the launch and recovery are carried out away from the ship's side. Here the FRC is stabilised by a frame around the hook-on point engaging with a docking frame suspended from the davit head. The FRC is hoisted into this docking head which then serves to stabilise the movement of the boat during the transit from the ship's side to the stowage. This system tends to be used more with daughter craft where a heavier boat is being launched and recovered.

Whilst there are alternative systems to help stabilise the boat during launch and recovery when it is well clear of the water, the critical part of the launch and recovery is the hook-on operation. Efficient launching is well catered for by the off-load release system but there is no easy and effective hook-on system. This is where crew members can be at risk and later sections of this report will focus on this.

5. PROPRIETARY LAUNCH AND RECOVERY SYSTEMS

5.1 SCHAT HARDING

Miranda davit being used to handle an FRC

The rescue boat davits produced by Schat Harding are aimed primarily at the SOLAS requirements and their hoist speed does not meet the current 60 m/s that is used in the offshore oil industry. However this could be changed and this company offers G-type davit and slewing davits that would be adaptable for offshore requirements. Wave compensation systems are available on the G davit.

Schat Harding previously marketed the Miranda Davit that was one of the first attempts to develop a launch and recovery system that would attempt to control the movement of the FRC during the hoisting operation. The Miranda is a very heavy structure and the control mechanism entailed having a sub-frame that was lowered with the boat attached down to the water. This sub-frame ran on rollers down the davit and the ship's side; the FRC was hooked onto the frame rather than the davit hoist and it was thus pinned against the frame during launch and recovery. Having this frame alongside the ship during recovery means that the recovery operation has to be carried out with the ship either stopped or moving ahead very slowly. As far as we could determine only one operator still uses the Miranda davit but does this successfully and also uses the systems for the launch and recovery of daughter craft.

5.2 NORSAFE

Norsafe offer a range of davit types to meet most requirements for the launch and recovery of FRCs and their equipment is widely used in the North Sea. The standard davit for FRC operations is a G-type davit with the hydraulic hoist winch mounted on the davit arm and a shock absorbing system on the hoist wire. Versions are available with a stowage system that automatically creates the stowage for the FRC as it comes into the davit and releases on launch. Larger versions are available with wave compensation systems and a docking head, these larger versions are used for daughter craft launch and recovery rather than FRCs. Norsafe is one of the few companies that offers rescue boats, connecting hooks and davits so is in a position to offer a fully integrated system.

5.3 HYDRAMARINE

Hydramarine davits are probably the most widely used in the North Sea and whilst they offer the normal G-davit they have also developed some novel systems including a low profile partially pivoting, partially slewing davit. In standard form the Hydramarine davits have the hoist winch mounted on the davit frame and a shock absorbing system on the hoist wire and the davits are offered with the option of constant tension and a docking head for controlling the motion of the FRC. Versions of the Hydramarine davits are available with sliding or fixed hooks that help to locate the FRC during the early stages of launch so that it movement is controlled up till the point where it can be located against the ship's side.

Hydramarine G davit

5.4 GRAMPIAN

Grampian Hydraulics is a relative newcomer to the FRC davit market but they have a long experience of servicing davits made by other manufacturers. Their davit designs follow convention and constant tension and a docking head are options.

5.5 CALEY

Caley only produce larger davits incorporating constant tension and a docking head that are mainly designed for daughter craft. They were one of the pioneers in this sector.

5.6 VESTDAVIT

Vestdavit is another Norwegian davit manufacturer but the main focus of this manufacturer is on the supply of SOLAS and specialised davit systems. Their FRC davit is of the conventional G-type with the winch mounted on the davit frame and they do make larger davit systems with constant tension and docking head systems and these are mainly used for daughter craft.

5.7 GENERAL

All systems seen in use operate effectively in the general requirement of transferring the FRC from its stowage and recovering it from the water to its stowage. The speed of the hoist wire is fast to minimise the time that the boat spends in transit between the davit stowage and the water and the luffing speed of the davit is fast to enable any swinging movement of the FRC to be controlled against the ship's side. Little attempt has been made to control any swinging movement of the FRC when it is in transit between the stowage and the ship's side apart from the hooks found on the Hydramarine davits and this is an area for development. Stowage systems and securing in the stowage are generally very basic and there is also room for improvements here to make the operation easier and safer. It is felt that with the high speed of the hoist wire, a hoist cut out at the davit head would be a safeguard to prevent to wire coming up 'two blocks' against the davit head and straining the hoist wire and fittings. In addition a system to slow down the hoist automatically during its last stage of the hoist could be beneficial.

6. THE USE OF SHIP'S CRANES FOR LAUNCH AND RECOVERY

Using a deck crane for launch and recovery offers advantages in that the crane is a versatile piece of equipment that can be used for other purposes such as survivor recovery in addition to the launch and recovery of the FRC. It can provide a cheaper alternative than dedicated davits because a crane is usually fitted to the ship anyway for handling equipment and stores and one crane could be used to launch FRCs on both sides of the vessel.

When using a deck crane for launch and recovery the boat is handled in a similar way as when operating a davit once the FRC is over the ship's side. It is when the FRC is being transferred from its deck stowage to a position over the side ready for launching that the FRC can be at risk from damage. Here the FRC can be subject to both rotation and the pendulum effect on the end of the crane hoist. The FRC can be located by using hand held ropes provided that it a relatively light and small craft but this increases the man-power requirements for launch and recovery and the weight of a larger craft could make it difficult to control it if the ship motions are large.

Crane launch and recovery system

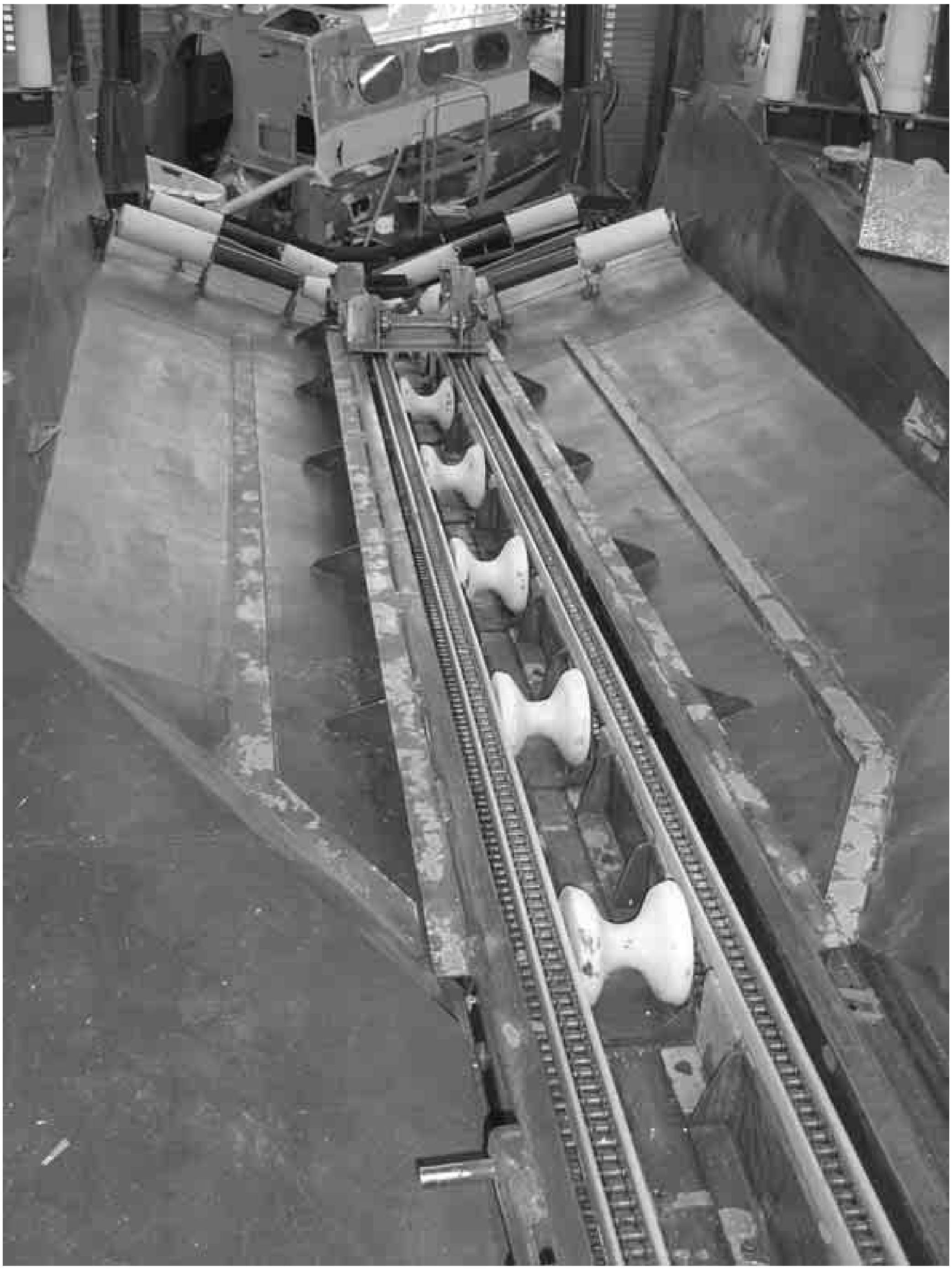
One solution to limit the boat movement would be to hoist the boat into a frame fixed to the end of the crane boom during recovery. Such a frame could be constructed from tubular steel or aluminium and it could be fitted with hydraulic control that could allow it to rotate in the horizontal plane in relation to the boom of the crane. Such a frame would be designed and installed so that it would not interfere with the normal operation of the crane hoist but it could be used to control both the rotation and swinging of the FRC during the transition phase of l launch and recovery between the stowage position on deck and the holding position against the ship's side. For a fixed boom crane, the rotation of the frame could be controlled by a parallel arm mechanical link.

During the launch operation the FRC would be lifted from its stowage and held tight into the frame. This would lock the boat into the frame so it could then only move when the frame was rotated, allowing it to be aligned fore and aft as the crane boom was swung outboard. Once the FRC was lined up fore and aft and was outboard then the crane boom or the hoist would be lowered to a point where the FRC was located against the side of the ship and stabilised. Launching would then entail lowered on the hoist wire with the crane boom adjusted in or out to hold the FRC in relation to the ship's side.

Recovery would use the system in reverse with the FRC being hoisted and stabilised against the top of the ship's side. At this point the crane boom would be lowered so that the frame engaged with the FRC then once the FRC was locked in position in the frame it could be transferred safely to its stowage on deck. The frame could be designed to engage with the tubes of the boat or it could engage with a frame around the lifting hook as it used with some sophisticated davit designs such as the Caley.

In all systems using a crane for launch and recovery the crane should be fast acting in the extending, swinging and hoist operations. Generally speaking a crane with an extending boom is preferred for this type of operation rather than a knuckle boom crane.

7. SLIPWAY LAUNCH AND RECOVERY



Slipway launch and recover system on a German lifeboat

Our study included looking at slipway launch and recovery systems in use by other organisations in order to see whether these might be a practical alternative to davit launch and recovery. The German Lifeboat Organisation has the most experience of this system and they use it effectively to launch and recover a small daughter boat in rough conditions. It has taken them many years of development to perfect their system which uses a transom gate to close off the slipway when not in use. For launching this gate is lowered to below the waterline to extend the length of the ramp and a simple release launches the daughter boat stern first into the water. Recovery involves driving the boat onto the ramp where a continuous chain rack engages with a contact on the keel of the boat so that it is automatically pulled up the slipway. Guide rails help to make sure that the boat enters the slipway cleanly.

With this highly developed system the crews can launch their boats in virtually any conditions in which the boat can operate safely. Recovery is the more difficult part but they seem confident that this can be achieved in most conditions. During recovery the mother craft steams ahead at a speed where the pitching motions are minimised and generally, the limit of recovery conditions is dependent on the keeping the lower edge of the extended slipway underwater so that there is no risk of the boat getting trapped underneath.

Having watched this slipway system in operation we are of the opinion that it can extend the conditions in which a boat can be launched and recovered from a mother ship but it does require extensive modification or adaptation of the mother ship to accommodate the slipway. This modification is required at the stern of the vessel and it could compromise the towing capability of the ship although in this lifeboat application the towing capability has been maintained.

Norwegian operator Havilia has built a slipway into the stern of one of its latest stand-by ships and this appears to work effectively although they are still in the early stages of developing this concept. On this ship the daughter craft and FRCs are normally launched and recovered by davit systems and the slipway recovery remains an option if the davits cannot be used or if injured survivors are on board. The slipway was originally conceived as a means of recovering a lifeboat if that was the chosen means of evacuation from a rig or platform.

Slipway launch and recovery is a viable option but it could be costly to incorporate it into existing vessels. It can be built into new vessels more readily but the incentive for this option probably has to come from the operators who charter the vessel rather than from the stand-by vessel owners. The use of a slipway launch would extend the operational capability of a daughter craft but it is less applicable to the lighter FRCs although on balance it does appear to offer a safety means of launch and recovery by removing the need for hook-on and release systems.

8. THE HOOK-ON SYSTEMS CURRENTLY IN USE

The hook-on and release process is considered to be the area where the crew are most at risk and despite the introduction of specialised hooks this still presents the area that tends to limit the conditions under which the FRC can be used. In particular it is the connecting of the hoist wire that presents the challenge and limitation for the launch and recovery operation.

8.1 HOOK AND EYE

This is the traditional method that comprises a snap hook on the hoist wire and a ring attached to the flexible slings on the boat. It requires two hands to operate the system, one to hold the hook and one to lift the eye into position for the connection. The hands of the connecting crewman are very close to the point of contact and there is also the risk that once the connection has been made, the slings will snap tight with a consequent risk of injury to all crew on board. Proponents of this system claim that because neither component of the connection is fixed, it is easier to make the connection. A modification to this basic system being tried is to have a portable pole that can be used to support the ring in a fixed position, which will help to allow the connection to be made one-handed but erecting the pole does not sound to be an easy operation and at first acquaintance with this system it seems doubtful whether there will be a significant advantage in its use. The initiative for developing this alternative system has come from the difficulty in converting an FRC from a flexible sling system to a fixed hook-on system. This can be a complex job, involving possible major surgery on the FRC’s structure.

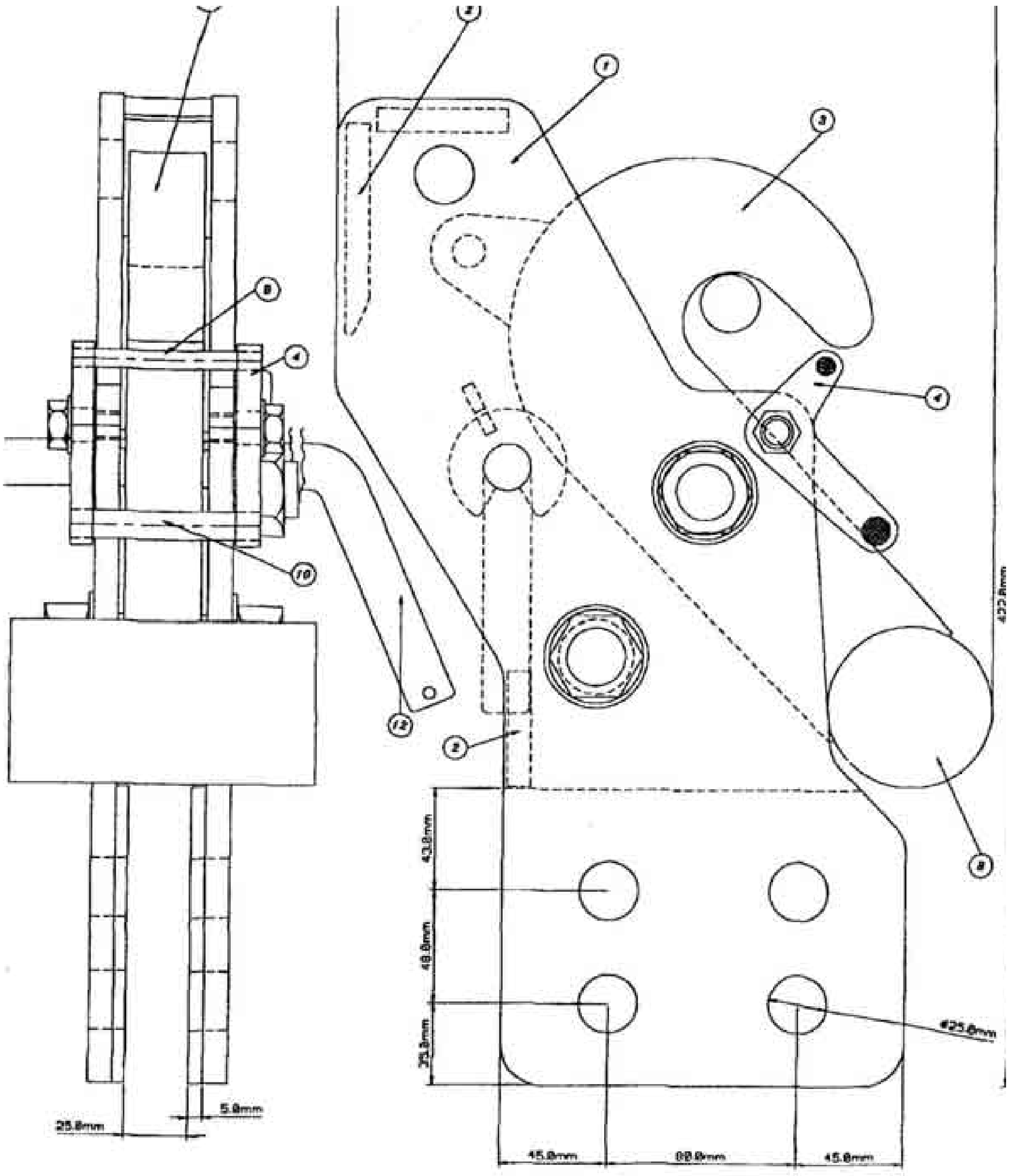
8.2 POLE AND HOOK

This system is a development from the hook and eye system and in its basic form uses a fixed eye on a pole to replace the flexible slings. By having a fixed eye it is possible to incorporate a double eye, one in front of the other so that the hook-on point can be adjusted according to the loading of the FRC. This could be a bonus when recovering survivors and the FRC returns bow heavy. This system has been developed by operator Esvagt in Denmark and they have also modified the snap hook so that it can be operated one-handed and with the hands away from the hook-on point. This is done by having a rod handle attached to the main body of the hook extending out away from the connection side of the hook. A second similar handle is attached to the tongue of the hook and when the two handles are brought together, the hook can be disconnected quickly and easily, one-handed. For hooking-on the same approach is used, the two handles and brought together, the connection made and then the handles released. This system does seem to work in practice and the connection can be made and released one-handed but it does require a degree of practice to make it work.

The modified snap hook used by Esvagt that is combined with a pole and hook system

8.3 HENRICKSEN

This company has made a speciality of designing hooks for use by FRCs and their hooks are based on an off-load release system that automatically disconnects when the load comes off the hoist wire. Such a system is good for the launch of the FRC as it means that the crew do not have to be in the vicinity of the hook when it is released. The hook is located within the boat; generally mounted on a substantial frame around the engine housing on a diesel inboard powered FRC and this can add considerably to the weight of the FRC. A safety catch has to be set before the hook will release automatically on off-load.



Henricksen off-load hook

Making the connection on recovery is not automatic and entails one of the crew inserting a ring into the hook. Henricksen has developed special rings with side handles that allow the crewman to keep hands away from the actual connection area but these would normally require two-handed operation and this operation is not easy when the boat is moving and jerking. Another design of ring has a double eye, one above the other with the handhold between them that is claimed to make it easier to carry out the operation one-handed.

8.4 NORSAFE

The Norsafe hooks are very similar to the Henricksen units and operate in a similar way.

8.5 HYDRAMARINE

Hydramarine make similar hook-on systems to those offered by Henricksen and Norsafe

8.6 AUTOMATIC SYSTEMS

Release of the hoist wire is well covered by the off-load release systems offered by Henricksen, Hydramarine and Norsafe but this still leaves the problem of hooking on. A degree of automation for the hook-on procedure is found in the wave or constant tension systems found on more sophisticated davits where the height of the hook or ring is adjusted automatically once a light sensor wire or rope has been attached to the FRC. This then means that the hook or ring is kept at a matching height to the connection point so that attachment will be easier. However such a system still requires human intervention and both Henricksen and Norsafe are working on more automatic systems where the connection is made without human intervention once an initial light line connection has been made. Hydramarine has such a system that is currently available on the market. Such systems with their associated complication are likely to find application on daughter craft recovery rather than for FRCs where the complication may offset the benefits.

9. THE ROLE OF THE MOTHER SHIP

The way in which the mother ship is handled during the launch and recovery of an FRC can have a significant effect on the success of the operation. The object should be to reduce the movement of the ship in waves as much as possible whilst at the same time creating a lee that reduces the rise and fall due to waves alongside in the area in which the FRC is to be launched. During our study we have noted that different techniques are in use to achieve these effects and these are explained and analysed.

9.1 WIND ASTERN

A number of stand-by vessel skippers use the technique of operating the vessel with the stern into or nearly into the wind whilst maintaining a slow speed ahead during launch and recovery. The reasoning behind this technique is that by running before the wind the speed of the waves passing the ship will be reduced and this will give a slower rate of rise and fall for the FRC when it is alongside and facilitate the hook on and release operation. During this operation it would be normal for the ship to be angled in relation to the waves so that the wind is on the quarter away from the side on which the FRC is launched thus provides a form of lee alongside on the launching side.

This method does seem to work reasonably well in moderate condition but in larger waves it is thought that it would increase the rolling motion of the mother ship, thus making the launch and recovery operation more difficult. The reason for this increased rolling would stem from the fact that the righting moment of a ship is considerably reduced when the hull is supported mainly by a wave amidships as it passes under the ship. In head seas the passage of a wave past the ship is transient and for the short time that it is amidships the reduction in stability is not noticeable. In following seas where the ship and the waves are moving in the same direction the passage of the wave past the ship will be slower and thus the reduction in righting moment will be more prolonged and result in an increase in the rolling motion of the ship.

Recovering the FRC when the wind is astern of the mother ship can also increase the risk to the FRC. When the wind induced waves coming from astern combine with the wash from the ship it can create some areas of breaking waves. These could be located in the region where the FRC makes its approach to the mother ship and if the FRC encounters these breaking waves from astern at the time when it is going slowly in making its approach this does introduce a risk of capsize. Three FRC capsizes have been reported in the Danish sector and as far as can be analysed, these have occurred during this sort of situation. An FRC capsize is most likely when it is operating with the wind and seas from astern and with the FRC operating at slow speed. It can be a very sudden event that can occur with very little warning and mother ship skippers should be aware of this risk and consider carefully the situation when recovering the FRC with the wind astern or nearly astern in heavier seas.

9.2 WIND AHEAD

Traditionally boats have been launched from ships with the ship heading on a course of around 30 degrees off the wind. This creates a lee alongside the ship and at the same time the ship presents a reasonably stable platform for the launch operation. The angle between the ship's heading and the wind may be varied and the skipper has to find a delicate balance between creating an effective lee and reducing the ship's motions to a minimum. The best lee is likely to be with the wind on or nearly on the beam but the ship is likely to be most stable in terms of rolling when the wind is close ahead.

A compromise can be found by initially heading into wind when the FRC is being prepared for launching and then gradually swinging the ship's head off the wind as the FRC is launched so that the ship will end up on a heading of around 60 degrees off the wind when the launch is completed. The turning motion of the ship has the effect of creating a better lee alongside than if the ship is maintained on a constant heading. The same process is used for the recovery operation.

It is recognised with this method that the launching operation has to be completed within the time of turning as once the ship gets to the 60 degree angle off the wind it is likely to start rolling more heavily. This method does have the advantage that the ship maintains headway into the waves and that it likely to create dynamic stability to help stabilise the motion of the ship.

9.3 VESSEL STOPPED

Launching and recovering the FRC when the mother ship is stopped or just moving forward is an option and is a requirement when the Miranda davit system is used. With Miranda, the launching frames in the water are likely to move away from the ship's side if there much headway on the ship.

With other davit systems, the launch and recovery at very slow speed or when stopped is likely to induce heavier rolling because the ship looses its dynamic stability where the forward motion of the ship helps to keep it stable. The other aspect of operating when the mother ship is stopped is that it will be less easy to control the FRC alongside without the flow of water past the hull to allow control as when the FRC and mother ship are moving at or close to the same speed.

9.4 LOCATION OF THE DAVITS

The davits are best located at the point of minimum ship's movement which is likely to be amidships or just aft of amidships. If the structure or other fittings on the ship do not allow the optimum point to be selected then it is better to have the davits further aft than forward as this will allow for a generous scope of painter to be used. There should be a clear view of the launch and recovery operation from the bridge and the davit controls also need to be located where there is a clear view of the whole operation. Communication links between the bridge, the launching control station and the FRC are essential for smooth operations.

10. REQUIREMENTS OF AN INTEGRATED LAUNCH AND RECOVERY SYSTEM

To a certain extent every system being used is an integrated system because all the components have to work together if the FRC is going to be launched and recovered and to operate satisfactorily. However the three components of an effective system, the davit, the FRC and the hook on system that connects the two are usually procured individually so that they need to be adapted if they are going to be effective. Procuring all three components from one supplier offers the prospect of better integration and also provides a single point of contact if there are problems. There can also be the question for the system working effectively once installed and a one source supplier should take responsibility for this.

The sort of problems that can occur if the components are supplied individually is that if the stowage for the FRC in the davit does not fit and requires modifying, the fittings on the hoist wire and the boat may not be compatible and the hoist fittings in the boat may not match those of the davit. There are no standard fittings for this type of installation and by obtaining the components from one source there is a better chance that everything will fit and be effective. A manufacturer who produces all three components is also likely to have a better understanding of how they inter-act and be more aware of the subtle differences between good and mediocre systems.

The requirements for an integrated system are very straightforward and it is simply that each component matches and works with the other. It sounds obvious but rings have to be sized to work with hooks and boat stowages and securing systems have to match the boat but on looking at some of the installations it became obvious that this is not always the case.

11. FEATURES REQUIRED FOR AN OPTIMUM LAUNCH AND RECOVERY SYSTEM

FRC pinned in against the ship's side ready for launch

In calm sea conditions where the mother ship is not moving then the launch and recovery of an FRC is a straight-forward exercise but even then there are certain features required in order to make the operation safe. These are:-

- The ability to hold the FRC alongside the hull of the mother ship to allow the loading or discharge of crew and survivors, both fit and injured.
- The use of a painter to hold the FRC under the davit in the event of difficulty or delay in releasing the lifting hook or when hooking on the lifting wire
- The need to minimise sharp movements of the FRC when alongside the mother ship. Any sharp movements could catch the crew unawares, particularly during the hook-on procedure which may require two hands for the operation so that the crew may not be firmly secured in the FRC
- The fitting of a cut-out switch at the davit head to prevent to hoist wire coming up 'two-blocks' during the hoisting operation and putting excessive strain on the equipment.
- The need to have the davit control position located with a clear view of the launch and recovery operation and with communication facilities linking the bridge of the mother ship and the crew of the FRC

In addition, when the mother ship is rolling and pitching the following are required:

- The ability to luff or swing the davit arm quickly to reduce the time that the FRC might be suspended freely or to hold the FRC alongside the mother ship's hull to stabilise its movement.
- Effective means of controlling the motion of the FRC in relation to the davit/mother ship, particularly during the initial phase of launching when the davit is being luffed out.
- A rapid hoist and lowering speed to minimise the time that the FRC may be freely suspended.
- An effective hook-on and release system for the hoist wire.
- An effective davit control system that allows quick and logical control of the hoist and luffing systems to reduce the chance of mistakes.

12. REQUIREMENTS FOR THE FRC/HOIST CONNECTION

Connecting and releasing the hoist wire from the boat is the most critical part of the launch and recovery operation. It is the ability to do this safely that largely dictates whether the FRC can be launched and recovered. A number of different systems are used for this but they mainly divide into three categories:-

12.1 ON-LOAD RELEASE HOOKS

These are a requirement for SOLAS approved lifeboats and rescue boats and they allow the hoist to be disconnected when it is under load. The demand for this type of release stems from the possibility of a boat being launched without a painter being used and so the boat could end up being towed by the host ship if it were not possible to disconnect the hoist wire when it was still under load. A safety lock is provided to reduce the chance of inadvertent release. This type of hook requires the hoist wire to be connected manually for lifting. Some types have the hook mounted on the boat with a ring on the hoist wire but this is reversed on other types.

12.2 NO LOAD RELEASE HOOKS

This type of hook will only release once the load has been taken off the hoist wire and the safety catch has been set for release. Release can often be achieved by remote control via a cable to a lever at the helm of the FRC. To make the connection using this type of hook requires the hoist wire ring to be inserted manually and this type of hook is mounted in the boat with a ring on the hoist wire.

12.3 CONVENTIONAL SNAP HOOK

This is the traditional way to make the connection between FRC and the hoist. The hook is a standard hook with a spring loaded clip to close and secure the hook opening once the connection has been made. This makes connecting a relatively straightforward operation but disconnecting means first opening the tongue before the hook can be slipped. Designs vary but disconnection can usually be done from outside the hook enabling the hands to be kept partly away from the connection interface. This type of hook is attached to the hoist wire and may connect with either a fixed ring on the boat or a loose ring attached to flexible slings.

There is no demand for offshore oil FRCs to have hooks with specific features other than to ensure the safest possible operation. The variety of systems in use demonstrates the diversity of opinion about the best system but the type of system used is also influenced by the construction of the FRC used because it is difficult to retrofit alternative systems without major changes to the FRC.

The main requirements for a connection system are:-

- That the connection can be made and released without the crew having their hands close to the connection point.
- Release should only be possible once the hoist wire is slack.
- The connecting point on the FRC should be a fixed point in the boat.
- It should be possible to release and make the connection one-handed so that the crew member has one hand to hold on with
- The FRC should be capable of being held steady during the hook on process with the minimum of jerking.

13. INTEGRATED LAUNCH AND RECOVERY SYSTEMS

If launch and recovery operations are to be carried out successfully then it is vital that the three main components of the system are fully integrated. Because the FRCs, their davits and the connections between the two have been developed on an ad hoc basis, the three components have traditionally been developed by separate manufacturers. They may be specified by the builder of the mother ship or by the owner/operator of the vessel and it does appear that little thought is given to integrating the systems, with operation of launch and recovery having to be developed by the users on board.

This approach is changing, particularly amongst Scandinavian operators and there are manufacturers there who can supply the complete package of davit, boat and connection. However, even there, it does not appear that a great deal of thought is given to fully integrating the components as far as FRCs are concerned. There does appear to be a better approach towards integration as far as handling the larger daughter craft are concerned but again there is still scope for improved and more integrated systems.

Manufacturers have moved towards offering integrated systems but we feel that there is a lack of experience amongst operators to fully appreciate the options and alternatives. This can particularly apply to the crews on board who are presented with equipment they are expected to use without much consultation about the development. There is little attempt at feed-back to the shore personnel responsible unless there is an accident and we feel that a lot could be achieved by bringing in expertise that could study each installation and recommend improvements. This should be done before a system is installed rather that trying to modify an existing installation but even in the latter case a lot could be achieved in developing a more efficient and integrated system with detail improvements.

The main areas where there is a need for better integration are in the hook-on connection system, the painter line and its connection, the control of the FRC during the period of its transit from its davit stowage to a position alongside the ship's side and in the provision of crew security in the FRC during the critical period of launch and recovery.

14. ALTERNATIVE LAUNCH AND RECOVERY SYSTEMS FOR DAUGHTER CRAFT

There have been significant advances in launch and recovery systems for larger craft such as the daughter craft used in offshore oil operations with the introduction of specialised davits and closer integration between the boat's fittings and those on the davit. Specialised hook connections have also been developed.

The main difference noticeable between the way that daughter craft and FRCs are launched and recovered appears to be that daughter craft in most cases are kept away from the ship's side, using the specialised davit fitting to stabilise the boat whilst FRCs use the ship's side for this stabilisation. On the daughter craft installations, the davit is fitted with a docking head and this engages with a matching docking fitting attached to the boat. Once these two fittings are engaged then the movement of the boat is controlled and the boat is held relatively securely enabling it to be stowed safely in its davit cradle or lifted from the cradle into a position ready for launching. Because the boat is held against movement by the davit head, it becomes feasible to launch the boat away from the ship's side. This location away from the ship's side is often helped by using a boom extending out from the ship's side from which to deploy the painter. However, on many of the installations that we have viewed that use a boom in this way, the positioning of the boom is such that the painter line is quite short so that it is more likely to cause jerking on the painter line and the painter line tends to lead upwards at a considerable angle from the boat.

This certainly reduces the risk of the boat banging against the ship's side and unsettling the crew but it does create quite a gap between the boat and the ship's side at the boarding point, introducing another hazard for the crew. This gap can be closed temporarily by luffing the davit so that the boat is close alongside.

The boat is free to swing in the short time it is being lowered or hoisted to or from the water, but with a fast hoist this time is minimal. The exposure to risk for the crew still comes during the hook-on procedure which has to be done manually and these risks can be reduced but not eliminated by heave compensation systems that keep the hoist wire moving up and down in relation to the movement of the boat. A further development are automatic connection systems that make the link between hoist and boat automatically once a light line has been connected, but such systems are either still at the development stage or are not fully proven in practice.

One of the major problems with the hook-on systems for daughter craft is that the fitting on the daughter craft is generally located on the top of the wheelhouse. This means that the crew have to climb up there in order to make the connection. This risk is being recognised in some installations by having side cages alongside or aft of the wheelhouse where the crew can locate themselves. Because the boats are considerably heavier that FRCs, the hoist and connection equipment has to be more robust and thus much heavier and this can make the task of the crew hooking on considerably more difficult. There is a need for more research and development work to be carried out into this aspect of launch and recovery but the cost is not easy to justify because of the relatively small market and thus sales of any equipment that might be developed.

The sophisticated systems that have been developed for handling daughter craft are being used in some cases for the launch of FRCs but in most cases the additional cost of the davits and fitting is not justified against the benefits that might accrue from using them in FRCs. However FRC launch and recovery could benefit from similar research and development but again the high cost of research can rarely be justified commercially by the relatively small market.

15. MAINTENANCE

An analysis of those accidents involving FRCs and their launch and recovery systems that we have seen reported suggests that poor maintenance could be one of the primary causes. Maintenance levels on a day to day basis appear to be reasonably good but it does appear that more attention needs to be paid to the regular replacement of some items before failure occurs. The failure of hydraulic hoses is one area where replacement could help and the attitude does appear to be to wait for failure before replacement. Such a failure is not necessarily critical to safety but any failure will reduce the crews' confidence in the systems and that is not a good thing.

Davit winches have to be overhauled every five years as far as we can ascertain, but this seems to be a long interval and more regular attention could reduce failure levels. Maintenance by replacement would appear to be a better system to bring into operation but we suspect that manufacturers do not like to recommend this as it could reflect on the reliability of their equipment. Inspection of the hoist wire at frequent intervals should also be encouraged so that any deterioration can be discovered at an early stage. A regular inspection and maintenance schedule would appear to be appropriate from both davit and FRC so that small faults can be discovered and rectified before they become a major problem through failure.

16. REQUIREMENTS FOR AN EFFECTIVE FRC IN TERMS OF LAUNCH AND RECOVERY

There are three main requirements of an FRC to improve the safety of the crew and the effectiveness of the release and hook-on procedure:-

- That the FRC provides a stable platform when it is alongside the mother ship during the launch and recovery procedures. This means that the impacts alongside the ship are minimised and the jerking pull on the painter is reduced.
- That the crew can locate themselves securely in the boat during the launch and recovery procedures.
- That the release and hook-on procedures are simple, quick and effective and can be operated preferably one-handed.
- That painter connection and release systems are simple, quick and effective and can operated preferably one-handed

The foam or inflatable fender around the hull of a rigid inflatable can be an effective cushion to reduce the impacts when alongside. An inflatable tube is going to be more effective than a foam tube and the inflatable tube will be particularly effective if the tube pressure is maintained at around 2 psi so that it will absorb the impacts rather than bounce off the ship's side. No projections or rubbing strips under which the boat could catch, should be allowed in the area of recovery

To minimise painter snatch and jerking, the painter should be as long as practical and should be made from a rope that has considerable stretch such as nylon so that the impact of snatching will be reduced. By making the painter as long as possible the catenary of the rope will also act to absorb shock loading and snatching and will make the pull of the rope more horizontal. Unless a boom is used, the angle at which the painter pulls on the boat will tend to pull the boat into the ship's side and that is likely to lead to heavier impacts. If the attachment point (on the FRC) for the painter is moved to the side nearest to the ship's side then the pull on the painter will be more nearly in the fore and aft direction of the ship and this should reduce the alongside impacts. It should also help departure from alongside when the FRC is launched and is ready to leave the side of the ship.

Most operators that we have seen attach the painter to the FRC by means of a clip hook. This simplifies the procedure during connection but does not make for a quick and easy disconnection. There are automatic systems for disconnection that allow the painter to be disconnected from the helm position by pulling on a handle and in some cases these are inter-connected with the off-load hook so that the painter cannot be released before the hoist is disconnected. However the added complication of these systems tends to restrict their use to daughter craft rather than FRCs.

Simplicity is the key to safe operations in an FRC and it would appear that a simple eye in the end of the painter that could be placed over the bollard in the FRC would combine the requirements for a simple attachment and release. If a tail rope is attached to the eye then this could be pulled backwards to simplify the connection and release operations and keep hands away from the actual connection point. An alternative simple system is to attach the painter with turns around the bollard but this means extra line inside the FRC that could tangle with the legs of the crew.

Painter attachment release system on a training FRC

To help the crew locate themselves during the hook-on and release procedures there should be handholds provided in the vicinity of the hook on point. It should be possible to perform the hook-on procedure one-handed and this will demand not only that one side of the connection is fixed in the boat but that the connection on the hoist wire is kept as light as possible commensurate with the required strength. The hook-on contacts use relatively lightweight fittings on small FRCs such as those with outboard power units but the size of the fittings increases considerably with larger diesel powered FRCs and daughter craft so the fittings on these craft require particular study.

Where a snap hook is used on the end of the hoist wire one type of fitting that could be used in the FRC is shown in the diagram where the side rail on one side of the post provides the handhold for the crew and the side rail on the other, the hook on point. This side rail hook-on point allows greater flexibility in where the hook is placed as it will slide to the top once the hoist comes under tension and it also allows for alternative lifting points to compensate for changes in the FRC centre of gravity.

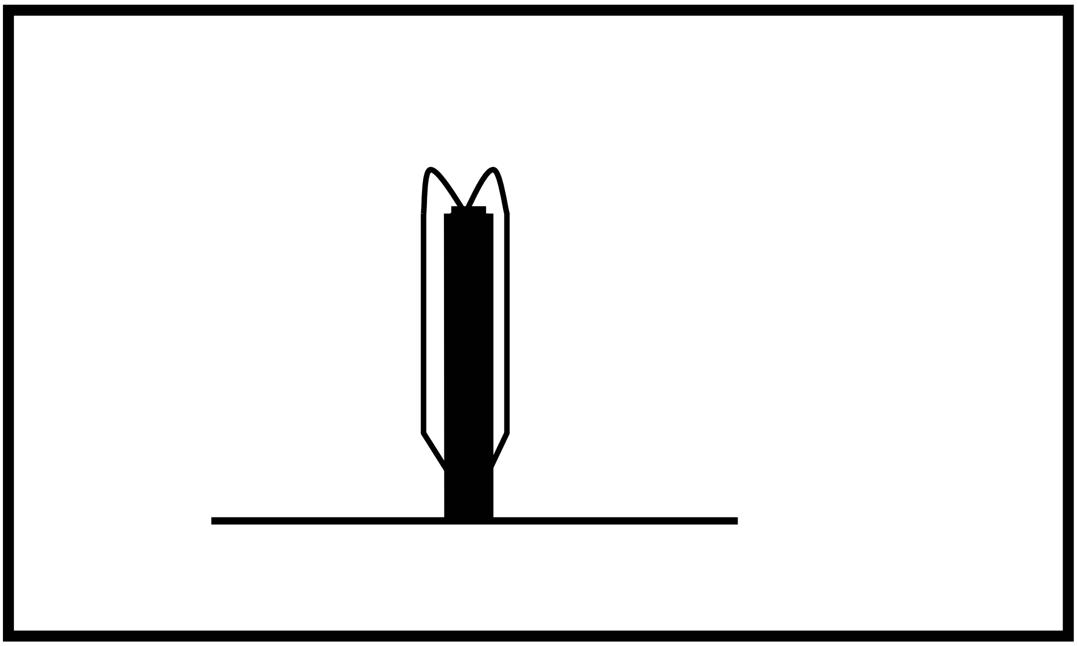


Diagram showing a proposed fixed post hook-on system with two side rails, one of which can be used as a handhold and the other for attaching the hook. This system also provides alternative lifting points for the FRC.

Where heavier lifting equipment is required to be hooked on then a new approach is required and this could involve connecting a light wire or rope first and using this to being the two points of the connection together.

17. HEALTH AND SAFETY REQUIREMENTS FOR CREWS OPERATING FRCs

The environment in which FRCs crews operate would be considered a high risk area, with threats of injury coming from the following:-

- Risk of capsize of the boat
- Risk of falling overboard both when alongside and in the open sea
- Risk from loosing grip and being thrown against a rigid part of the boat
- Risk of slipping when moving about in the boat and striking a solid part of the boat
- Risk of injury and of being thrown overboard due to the violent movements of the boat
- Risk of injury from high 'g' forces when operating in waves
- Risk of head injury from objects falling from above when alongside or from being struck by the lifting hook or striking the head against a solid part of the boat
- Risk from fatigue, cold and seasickness
- Risks emanating from the incident, eg. Fire etc.
- Risk of finger/hand entrapment or pinching during hook on & release

To counter these risks the following are required either in the boat or as part of the crews' personal equipment:-

- Suitable protective clothing that is both waterproof and provides immersion protection at least to SOLAS standards.
- Head protection in the form or a safety helmet.
- Handholds located in the boat at all points where the crew might have to operate.
- Toeholds adjacent to any seating
- Shock mitigating seating that also provides good location for the occupant.
- Non-skid deck material. This can also incorporate a shock-absorbing capability.
- The removal or padding of all sharp edges likely to cause injury.
- Hull design that cushions the ride of the boat in waves.
- Engine and steering controls that allow easy and sensitive control of the boat.
- Hook design to reduce or remove entrapment risk

These factors will be studied in more detail in later sections of this report but they cannot generally be considered in isolation. Emphasising one aspect of protection could have an adverse effect on another and what is required is a balanced and integrated approach to the health and safety requirements to achieve the best results. It should also be remembered that crews are likely to experience much more extreme conditions during an actual rescue operation that they will during training or routine use of the FRC.

18. ALTERNATIVE TYPES OF SEATING IN FRCs

Seating performs two functions in an FRC. Firstly it provides a means of locating the crew in the boat and secondly it can provide a means of shock mitigation to help absorb some of the vertical accelerations that can occur. The saddle seat was developed for the original rigid inflatables over 40 years ago and proved to be a great advance over previous types of seating but seat design has moved on and today there are several more sophisticated types of rigid inflatable seating that may be worthy of consideration.

The requirements for FRC seating may be summed up as follows:-

- It should help to securely locate the crew member in the boat against the often severe movements of the boat
- It should provide a means of shock mitigation against the vertical accelerations the crew may have to endure when operating at speed on open seas.
- It should provide lateral support for the crew against the often violent sideways movement of the boat
- It should be fitted with adequate handholds and toe holds to further help the crew secure themselves in the boat.

Double console and staggered saddle seating on an FRC

After looking at a wide variety of FRCs it appears that none of those in operation or being offered by manufacturers fully meet these criteria. The saddle seat is the generally accepted solution and this is padded with a layer of foam to give a degree of shock mitigation. The saddle seating is often arranged in a tandem or triple seating arrangement in a fore and aft line. This arrangement means that only the crew on the front of the seat can do useful work and the remaining one or two crew members are often in close contact with the others and with very little view of what is going on in or outside the boat.

More sophisticated types of seating may have individual seat units that are sprung to add to the shock mitigation capability. There is often space for these to be mounted side by side which gives the two front crew the ability to take an active part in the working of the boat. A third crew seat may be placed centrally between the two front seats so that the third crew member at least has a view forward. These individual seats will normally have a back rest with will help with support and location on the seat but there is little attempt at lateral support.

Lateral support is achieved through gripping the saddle seating with the thighs or knees but this is not generally satisfactory as the main weight of the body is above this level. Thus the trunk and the head can be subjected to a high sideways force and have little ability to resist it. Good handholds can help with this but the main requirement is some form of lateral support around the shoulders or upper body.

In the design of the seating in an FRC it is then necessary to consider various factors to achieve a solution that will provide the crew with a supportive form of seating that will help them to concentrate of the job that they have to do and to reduce fatigue and stress. Good seating will also create a safer working environment.

Each crew person should have an individual seat so that they are separated from their fellow crew members and each should have a view ahead to enable the crew to participate in search operations. These seats can be individually sprung but this is not considered to be too important and the right degree of shock mitigation can be achieved by careful choice and design of the foam padding. Sprung seating does increase the complication of the design and it usually requires greater demands on the limited deck space that may be available. A good handhold is essential except for the driver and toe straps can help with location on the seat. The seat should have a back rest and this should be curved round to provide lateral support at the shoulders but should also be designed to allow the crew to exit the seat rapidly when necessary.

During our research we have not found a seat or a seat layout that meets these criteria and it is thought that this is an area where research and development could prove valuable in increasing both the safety and the capability of the crew. A further look at the requirements for shock mitigation, handholds and toe holds will be found in the next sections.

19. CREW LOCATION IN THE FRC

An FRC will be moving all the time from when it has been released from its stowage to the time it is returned. When hanging from the hoist and when alongside the mother ship this movement is likely to be jerky and unpredictable and will be dictated by a combination of impact with the ship's side and the pull on the hoist and painter lines. Once launched and operating in waves, the boat motion can be more predictable but can still be subject to uncontrolled movements. In both these situations the crew and passengers cannot relax and they need to be provided with the means to locate themselves securely within the boat.

The motion of an FRC can be quite aggressive and one of the main causes of accidents in FRCs is when crew or passengers are not securely located in the boat and are subject to uncontrolled movements. One of the bonuses of the FRC with an inflatable tube is that this can provide a cushion for anyone thrown against it but there are still many hard spots in the boat such as the steering console and fittings, which can cause injury if one of the crew strikes them. Whilst locating the crew securely in the boat is one step towards reducing the risk of injury, the problem also needs to be tackled from the other direction with a look at how hard and sharp edges can be eliminated or padded. These edges can be found usually around the console, the windscreen and in the fore part of the boat. Elimination of these hard edges is primarily the job of the boat designer and builder but operators also need to take steps to mitigate this problem as far as possible.

19.1 HANDHOLDS

In looking at the criteria for placing handholds, it should be possible for the crew members to have a handhold of some type wherever they are in the boat. The focus of most FRC designs that we have seen has been to provide security when the crew are seated at the console. This tends to ignore the fact that the crew will be operating in the fore part of the boat during critical periods such as attaching the painter and hoist wire, when alongside another vessel or when recovering survivors.

All handholds in an FRC should be rigid. It is still common to see handholds made from plastic covered rope but such handholds only provide security in one direction, when the rope is being pulled and so are not satisfactory. Rope handholds can also injure the user if they are in use for some time by chafing the back of the hand where it can rub against the material to which the handhold is attached. Rigid handholds are normally made from stainless steel tubing which is not a particularly satisfactory material as it can be slippery when wet and in itself can create a hard edge that could cause injury. The best handholds that we have found for use in fast boats are the yellow handholds that are used in London taxis. These are robust, are covered with a plastic that provides a secure grip and coloured yellow so that they are easily seen to grab if a person makes a quick involuntary movement and wants security.

Starting at the seated position around the helm, handholds are required for each crew member with the exception of the coxswain. There could be a case for providing a handhold for the coxswain to use when getting in and out of the seat but he will not need one for normal driving where he will have one hand on the wheel and one of the throttles. The handholds for the other crew members need to be wide so that there is a good lateral span for the hands and to achieve this it can be a good idea to provide separate handholds for each hand. Good location of the handholds here is vital so that the person using them is seated comfortably and not having to stretch to use them. Where two seats are fitted at the console, the non-driver's seat handhold is often placed on the console where the user has to reach forward to use it. This is not good practice for prolonged use. In general, handholds around the helm tend to be placed where there is a convenient place to mount them rather than where they are best placed for easy use. This priority needs to be reversed and the location of handholds should be part of the basic design of the FRC.

A handhold around the top of the windscreen is a good idea as this not only serves to protect the top of the windscreen but also provides a handhold when moving forward. Finding a solution to the provision of handholds in the fore part of the boat is not easy and the best we have seen is the high rail that links the fixed hoisting post to the bow. This provides good security when standing forward but is high enough to easily duck under when moving from side to side in the boat. Such a handrail can help to provide security during the hooking on and release of the hoist and the painter. This type of rail handhold will not work in an FRC where a four point sling is used for the hoist.

Handholds are provided all the personnel in this FRC with the addition of a longitudinal rail

Handholds need to be provided at the hook on point for the hoist and at the bow where the painter is attached or released. Ideally these two operations should be a one-handed job leaving the other hand free to hold on with. Handholds in these two critical areas need to be carefully considered and should be integrated with the type of connection system that is used. Where two hands are required for the hooking on process a support that can be gripped by the knees could provide support to a degree. This could be a simple vertical frame that the crew member can straddle, leaving both hands free for hooking on. Much will depend on the layout of the FRC and its hoist attachment system but the need for such location should be considered in the design of the FRC.

19.2 TOE STRAPS

Toeholds or toe straps are used in conjunction with saddle seating. They provide a means of locating the feet when seated and because they enable the feet to be braced upwards as well as downwards, they can provide additional security. It is easy to slip the feet out of the loop for a quick exit and these are recommended features for any RIB that uses saddle seating. Unlike handholds that should be rigid, toe straps should be flexible because the only pull is upwards. Positioning of the toe straps is important because they do commit the user to that one position for the feet.

19.3 SEAT BELTS

Seat belts are a viable means of securing crew in a fast boat. They provide good secure location for the body, but they can only be used in conjunction with fully supporting seats. Such seating could be found on larger craft such as daughter craft and they are unlikely to be fitted to FRCs. If seat belts are used they need to be of the full harness type with twin shoulder straps and a waist strap; the webbing straps need to be padded to prevent chafe because the seat occupant will be going up and down against the straps. A quick release buckle is also essential and a quick connection system also helps.

It is unlikely that seat belts will be viable in an open FRC mainly due to lack of space for fitting suitable seating to which they can be attached. On a daughter craft or other types of enclosed boat that is designed to be self-righting in the event of a capsize then seat belts should be considered an essential fitting to prevent crew injury in the event of a capsize.

20. SHOCK MITIGATION IN FRCs

Shock loadings in RIBs come from three main sources:-

- The pull on the painter rope when alongside.
- The pull on the hoist rope and associated knocks when alongside the mother ship and other ships.
- Slamming when operating the FRC in waves.

Each of these factors can generate the type of instability that can lead to accidents and each needs a different solution.

Jerking on the painter rope usually comes from making this too short and using the wrong material for the rope. To provide a catenary effect that will reduce shock loadings, the painter needs to be as long as possible. Obviously the length of the mother ship forward of the FRC hoisting point limits the length but we have seen many ships where the possible effective length is not utilised and the painter is shorter than necessary. Not only does this lessen the shock absorbing capability of the painter but it also makes the pull more upward than the horizontal pull that is best.

Without exception as far as we have seen, the painter is made fast on the FRC along the centreline of the boat. This will tend to pull the FRC into the ship's side with a consequent increase in the banging alongside, particularly where a short painter length is used. It would be better to make the painter fast at its boat end on the side of the boat nearest to the ship's side. This will then make the pull virtually fore and aft and not bind the boat into the ship's side. A secondary benefit is that it will be easier to get the boat away from the ship's side with the painter made fast in this position.

During our survey we found that painters are invariably made from polypropylene rope. This rope has limited stretch and a better rope for this job would be nylon which has considerable stretch. Some types of nylon rope have more stretch than others depending on the lay of the rope and Matt Nylon is considered to be the one with maximum stretch and could be the best solution for painter ropes. Size for size, nylon rope is also stronger than polypropylene rope and thus the painter rope could be smaller in diameter, making it easier to handle. However, it should be borne in mind that nylon rope will normally sink so it will need careful handling from the mother ship to prevent it getting into the FRC's propeller.

The hoist shock loadings are dealt with mainly under the davit section but suffice here to say that the hoist should include a shock absorber system to mitigate the shock loading on the wire and hence on the boat.

Wave induced shock loadings that are often considered to be the main danger to the crews of FRC are the result of the hull slamming into waves when making progress at speed. The tendency has been to cope with these shock loadings by providing seating that will absorb the shocks to a degree. However this approach is rather like creating a problem and then finding a solution and the primary way to reduce these shock loadings should be in the basic design of the FRC hull.

All modern FRCs are based on a deep vee hull that is designed to cushion the ride in waves. However the degree of cushioning depends of the angle of the vee and this can range from a modest 12 degrees up to the deepest at 30 degrees. An FRC having good wave-cushioning characteristics would need a deadrise (the angle between the hull vee and the horizontal) of at least 20 degrees. This would be the starting point for a soft-riding FRC hull but the design should also avoid large flat surfaces in the chines and spray rails. Designers will often introduce wide spray rails and chines in order to allow the boat to plane more easily, but these flat surfaces, particularly those on the chines which are the furthest from the centreline of the hull will cause slamming when the boat is moving up and down in waves.

FRCs with hard foam tubing will also have a harsher ride than those with inflatable tubes. The foam tube has very little resilience and thus will not give when the tube hits the water. The inflatable tube will not only give because of the nature of its construction but it will also ‘roll over’ into the boat to help absorb some of the shock of wave impact. Inflatable tubes will only absorb impact if they are kept relatively soft, normally at around 2 psi. Any pressure higher than this will cause the tube to ‘bounce when it impacts with the water and this bouncing can lead to rapid and sometime severe movements of the FRC, generating the need for good lateral support for the crew. With both foam tubes and inflatable tubes the connection area between the tube and the rigid outside section of the hull should allow the water to flow smoothly away from the hull rather than trap it between the two.

With good hull design then there should be no need for fitting sprung seating. It is not so easy to control the boat when the seat is moving up and down as happens with a sprung seat and the extra cost, weight and complication is not easily justified unless it has to be fitted to compensate for a badly designed boat. Good saddle seating will do the job of shock mitigation adequately in most cases but the foam used need to be chosen with care to get the right shock absorbing characteristics. It is reckoned that the human body can absorb any initial shock loadings up to say 2 g. From 2 – 5 g requires a relatively soft foam and then a firm foam is required for any loadings above that. Thus for a well designed saddle seat there should be two layers of foam, one very firm at the bottom and then a softer foam above. With this combination the seat should be both comfortable and able to absorb most shock loadings.

With saddle seating the legs are used to absorb some of the shock loadings and special shock absorbing material laid on the deck can help with this. There are various proprietary materials available usually consisting of a skid resistant top and bottom layer with a cushioning layer in between. This material should be considered for fitting not only around the seating area but also forward in the working area where some form of non-skid material is required on the deck.

21. THE CONTROL AND NAVIGATION OF FRCs

As with any fast boat, a considerable proportion of the safety of the boat is in the hands of the person driving it. It is not the intention here to cover the driving of fast boats, that would require a book on its own, but driving a fast boat does require a considerable degree of expertise and concentration. One of the main differences between driving fast boats and driving slow boats is that things happen much more quickly in a fast boat. This may sound like stating the obvious, but driving a fast boat does require instant and in many cases instinctive responses from the driver and these can only be developed to a satisfactory level if the controls and instruments of the boat are correctly laid out for optimum use.

Rather like handholds, the controls and the instrumentation of FRCs tends to be added as an afterthought. They is not planned into the basic design but fitted more where there happens to be a space rather than fitted for easy use. Here we will cover some of the essential items and the way they should be installed for optimum use.

21.1 STEERING WHEEL

The steering wheel should be fitted at an angle to the horizontal of never more than 70 degrees. A lot will depend on the relationship between the seating position and the wheel but it should be possible to turn the wheel quickly and easily whilst at the same time being able to use the wheel to steady the coxswain against the movement of the boat. When running at high speed only very slight movements of the wheel should be necessary because sharper turning of the wheel can lead to the boat heeling over when it will slam in waves as the hull flat on the down side is exposed to them. So for high speed work the wheel should be geared low but at low speed it should be possible to turn the wheel rapidly to hard over, particularly with a water jet boat where the steering control is more vital to overall control. A compromise has to be reached between these conflicting requirements and usually one turn from amidships to hard over in each direction is about right.

21.2 THROTTLES

The throttles are probably the most important control in an FRC as it is vital to be able to get instant throttle response when driving in waves. The single lever style of throttle lever that incorporates gear change into the movement is the type generally used on FRCs, but in normal driving it is only the ahead section of the throttle movement that is used. Therefore the throttles should be mounted at an angle where this ahead section comes readily to hand and can be sensitively operated even when the boat is moving about in waves. The best angle would be with the midway point of the ahead throttle movement in the vertical position. To enable the throttle to be moved sensitively, some way to brace the throttle hand should be incorporated, perhaps as an arm rest or adjacent support.

21.3 TRIM CONTROL

Two types of trim control can be found on an FRC. One is flaps that are hinged plates attached to the lower edge of the transom. The angle of these flaps can be varied under electro-hydraulic control and these flaps would normally be used to keep the bow of the boat down in a head sea or to adjust the transverse trim of the boat. These are a slow acting control and the operating switch should normally be accessible to the co-driver as well as the driver. Flaps are not generally fitted to FRCs. The other type of trim is power trim and this is found on the more powerful outboard motors or on stern drives. It is used to alter the angle of the outboard in relation to the transom to optimise the propeller thrust for different speeds. The control is usually incorporated into the throttle lever so that it can be thumb operated. Many FRCs have neither of these controls fitted and in normal operation there is probably no requirement for them as they would be used to optimise the trim of the boat for different condition on a longer run.

21.4 ENGINE INSTRUMENTATION

If a set of audio alarms is fitted to provide warning of potential engine problems then the engine instruments do not need to be in front of the driver where they can be a distraction. An exception would be the rpm gauge and a fuel tank contents gauge. The rpm gauge can give the driver an indication of the speed but it also gives the driver an immediate indication of what the engine is doing which can be important in noisy surroundings when the engine note may not be audible. With a twin engine installation the rpm indicator will show immediately if an engine stops. The fuel contents gauge in not normally fitted but it can be useful on a longer search mission where it is not always possible to keep a mental check on what fuel might be left.

21.5 NAVGATION INSTRUMENTS

Most FRC navigation will be done by line of sight means but for poor visibility conditions or when the FRC might have to go some way from the mother ship an electronic chart plotter could be a valuable safety feature. However, such a plotter will not show the position of the mother ship and a better fitting for an FRC might be an Automatic Identification System (AIS) display. This would perform the dual function of showing the FRC the course and bearing back to the mother ship and it would also provide the mother ship with the location of the FRC. AIS installations use VHF radio for their communications links. If only one instrument is fitted then the AIS would be the one to use.

22. CREW FATIGUE AND SEASICKNESS

The need for concentration and a quick response were highlighted in the last section. Both crew fatigue and seasickness can affect these and the master of the mother ship needs to be aware of these possibilities and to take steps to prevent them. The crew of the FRC also need to be aware of potential short-comings though these causes and to take steps to prevent them.

Fatigue is very unlikely to be a problem during practice sessions because the boat is never in the water long enough for it to be a problem. However on a long search for casualties the problem can arise and it should be recognised that the required level of concentration for an FRC can normally only be maintained for around 2 hours. The problem can be partially overcome by having a second qualified person amongst the crew who can take over the helm but it often happens that it is the crew who are not at the helm who will suffer from fatigue before the coxswain. The coxswain has the focus of driving the boat whilst for the remainder of the crew it can often be a case of hanging on against the movement of the boat with little to focus the mind on apart from the pain. In that situation they are likely to suffer from fatigue before the coxswain.

The solution to the question of fatigue is quite simple and involves having a second crew who can take over after a 2 hour stint. With the limited crews carried on board stand-by ships this may not be possible particularly if there are two FRCs to be manned. In this situation the best solution would be to recall the FRC for a short break before sending them off again. In the adrenalin rush of an emergency situation arising fatigue will not be at the top of peoples' priorities but it can quickly manifest itself if the emergency translates into a long search.

If the FRC crew do extend their operations into the period beyond two hours or so then the possibility of fatigue should be recognised. Operating into the fatigue area is likely to lead to an increase in the possibility of an accident and this has to be balanced against coping with the requirements of the emergency.

Seasickness can have similar effect to fatigue but the causes can be different. For some sufferers just the change in movement from the mother ship to the FRC can exacerbate the problem. The motion of a fast boat whilst it is travelling fast is not conducive to sea sickness but long periods operating at low speeds could be a problem for some sufferers. Potential seasickness victims should try to keep their eyes on the horizon which is a good reason to have double seating at the helm rather than the inline seating. Alternating the low speed operations with time at higher speeds can also help.

In FRC operations it is important that each crew member keeps a check on the others for signs of fatigue and seasickness. Crew members who loll about in their seat or who do not maintain a tight hold could be showing the first signs and this should be recognised and dealt with before it leads to an accident. It is possible that any crew member who is a potential sea sickness sufferer will be identified during training sessions.

23. ENGINES AND PROPULSION

Most of the FRCs in the British sector of the North Sea use petrol fuelled outboard motors for FRC propulsion. These are simple self-contained units and the main attraction of these engines is that they can be easily replaced if an engine problem develops. This enables machinery defects to be solved at sea and it takes about half and hour to replace an engine. Also in favour of the outboard is its relatively light weight which helps performance and reduces the weight that has to be carried on the hoist wire and the fact that the normal twin engine installation gives added reliability.

Against the use of outboards is the fact that they use petrol as a fuel and this has to be carried in cans on deck and being more volatile than diesel, it can present an increased fire risk. The outboard also has exposed propellers that could present a danger to any survivors in the water.

The latest generation of FRCs built in Scandinavia are powered by diesel engines coupled to water jets. The water jet propulsion is required by the Scandinavian authorities because of the protection it offers to survivors in the water. The controls of a diesel water jet installation are not conventional and it is not always easy to make the change from conventional outboards to water jets without a degree of familiarisation. Added to this is the fact that an engine fault on the single engine installation may put the FRC out of action if it is not a simple problem that can be easily rectified.

A third option for propulsion that is found in the Danish sector is FRCs powered by diesel outboards. The maximum power of these outboard currently available is 35 hp so that these FRCs are considered to be under-powered with a maximum speed of a little over 20 knots. Propeller guards are fitted to these outboards which further reduce the performance but they do use fuel that is compatible with the mother ship.

So none of the current systems being used is the perfect solution for FRC powering and the military users of FRCs are faced with a similar problem. They are finding a solution in a new generation of diesel fuelled outboards which are based on conventional outboards but converted to run on diesel but they still use spark ignition. These outboards are still at the experimental stage and as presently configured, they are likely to prove expensive because of the limited numbers required. They are available in sizes from 50 to 200 hp and they may prove to be the best compromise solution once they are available commercially. They could be fitted with a propeller guard to provide survivor safety or a new type of propeller that incorporates a ring around its circumference which is claimed to give the required level of safety without compromising performance.

24. CLOTHING AND PROTECTIVE EQUIPEMENT FOR FRC CREWS

24.1 CLOTHING

FRCs operate in challenging condition in the North Sea particularly in winter so protective clothing is vital. Most crews wear immersion suits summer and winter and with the upcoming SOLAS requirement for immersion suits for all crew on board, the FRC crew requirements are well covered for this. There are two basic options available, one being a fully watertight suit that stops any water coming in contact with the body and the other what might be termed a flooding suit where the water comes into contact with the body but once there, is warmed by the body and does not circulate. Whilst the fully watertight suit would appear to be the best solution such suits are not generally suitable for constant wear and they do require regular maintenance if they are to retain their effectiveness. The flooding suit can be worn as everyday work wear and it still remains effective even when damaged to a degree.

Both types of suit are in use in the North Sea with the watertight suit generally used in the Norwegian and Danish sectors whilst the flooding suit is used in the British sector. The flooding suit is likely to have the crews in a better state of readiness for an emergency as this combines the immersion protection requirements with a suit that is suitable be regular work wear.

24.2 HELMETS

In the offshore oil environment helmets are generally a mandatory wear requirement. The industrial safety helmet is the standard but this is not generally suitable for use by FRC crews because the peak limits the upward visibility, which can important when alongside and the helmet does not offer thermal protection and the hoods attached to immersion suits cannot be worn underneath.

An alternative solution is found in the Gecko helmet that conforms to the BS requirements for a Marine Safety Helmet and which has passed the impact tests required for the industrial safety helmet. The foam lining of this helmet offers some thermal protection and it is possible to incorporate earphones and a microphone into the helmet so that it can meet the requirement for communications. An integral visor is available for spray protection, something that cannot be attached to the industrial safety helmet. With these advantages we are of the opinion that this type of helmet offers the best combination of practicality and safety for FRC use.

25. TRAINING

Training for competency in FRC operation currently consists of courses run by training schools using a combination of classroom instruction matched to practical on-water training. The courses are comprehensive and they assume a degree of maritime experience prior to taking the course. The on-water training is carried out under controlled conditions both in the calm waters of harbour and in the open sea.

The limitations of this training are recognised and it is backed up by at-sea validation on the mother ship with assessors regularly monitoring the launch and recovery operations and the operation of the FRC. This is the best that can be achieved under the current systems that place a high level of focus on the avoidance of any risk taking during training. This attitude appears to be strongly reinforced by the 'Duty Holders' who threaten to take standby vessels off charter if they incur accidents when training outside laid down parameters.

The current system does have weaknesses and these mainly relate to the usually benign conditions in which training is carried out. We are of the opinion that this could leave the FRC crews exposed to a lack of experience if they have to carry out rescues in more extreme conditions in real life situations. We would argue that it is better to expose crews to risk situations under the controlled conditions of training routines, than let them learn and operate in the unknown situation of an emergency situation. We are aware that a balance has to be struck between the potential risks involved in realistic training and suggest that a different approach to training could achieve this.

Another area that causes us concern is the lack of training in launch and recovery. At present this can only be done in the calm waters of harbour or when the mother ship is actually on service. A degree of training carried out during the assessment routines, but at this stage the crews are assumed to be capable of efficient launch and recovery. This method can pick up and rectify bad practices but there does not appear to be instruction in the fundamentals of launch and recovery and particularly in the training for the operation of the davit itself. Whilst acknowledging that there is no real substitute for practical open sea training for launch and recovery there could be merit in studying the role of simulators for this purpose. The RNLI is using simulators for training lifeboat crews in rough sea operations but have not developed the system for use with smaller inshore lifeboats as yet. A simulator developed to practice launch and recovery does not appear to be too challenging for the available technology and could prove to be a worthwhile investment that could be used for both offshore oil and SOLAS requirements.

As another way to rectify these training deficiencies we would recommend that consideration be given to training schools operating training ships either in place of their shore based establishments or in addition to the shore training. This could prove to be a more expensive solution but the cost of operating such a training ship could be amortised by also making it available for research and development of new launch and recovery systems, FRCs and similar equipment. At present manufacturers find it prohibitively expensive to charter ships to test out new equipment and this tends to restrict development.

The general shipping industry is faced with similar training dilemmas in trying to provide realistic training for FRC crews and in the operation of launch and recovery systems and IMO is currently engaged with this problem. Training ships could help here.

We re of the opinion that realistic training is vital to the successful operation of FRCs in the offshore oil arena and that an upgrade in the present standards is desirable.

26. REGULATION

The main aims of the options and changes that are proposed in this report are to improve the health and safety of the crews that operate the FRCs used in the offshore oil arena and to reduce the incidence of accidents. Accidents not only have the human aspect but they can also lead to the FRC and/or its mother ship being out of commission which in turn leads to a financial cost. A secondary aim of the changes is increase the operating parameters of the FRCs, allowing them to perform safely and effectively in more severe weather conditions. In many cases quite small changes could lead to greater effectiveness. Increased regulation would be one way to possibly achieve these aims but we are not convinced this is the way forward.
The experience of SOLAS in regulating for the construction and standards for operating FRCs from merchant ships has not so far created an effective system and in many cases crews have lost confidence in using these craft. The best form of regulation is the requirement for operators to demonstrate the effectiveness of their systems and the present operational framework in the offshore oil arena achieves this but it should leave the way open for further improvements. Improvements in systems have to be balanced against costs and the main motivation for the industry is to get the job done. Rather than detailed regulation, an outside assessment of systems in use by experienced personal could provide the best and most constructive way forward.

In terms of the design and construction of the FRCs and their launch and recovery systems, the SOLAS standards provide a good minimum standard and are generally accepted as the basis for the equipment is use in the offshore industry. This also fits in well with the manufacturers who can work to a common standard for both sectors but it has to be recognised that there are significant differences in requirements.

27. STANDARDISATION AND FAMILIARISATION

As crews will often change from ship to ship particularly amongst the ships of one operator, there is a strong case for standardisation of equipment and procedures at least amongst the ships of one fleet. This would mean that the crews should immediately be familiar with the equipment on a new ship and be able to operate it effectively. If crew members are faced with having to use different equipment from that which they are familiar with when they change ships then there should be a recognised familiarisation period for the crew with added practice sessions and training.

Even with standard equipment fitted to simplify the adaptation of crews to different ships, they may have been on shore for a month or more before they go back to sea and so there is a requirement for familiarisation. Successful launch and recovery and the operation of FRCs requires teamwork and we are of the opinion that each time a stand-by vessel goes to sea, time should be allocated for the crew to become familiar with the launch and recovery system and operating the FRC. We do not think that just one launch and recovery of the FRC is adequate for this and a routine should be established whereby as soon as the ship leaves harbour, the FRC should be launched and recovered say five times so that a routine becomes established. During this operation the FRC should also spend an extended time on the water, perhaps pacing the mother ship and allowing the crew to become familiar with handling the boat and recovering articles from the water. Such a familiarisation should be not delay the ship for long and it is better to carry out this familiarisation as soon as the vessel leaves harbour rather than wait until it is on station where the conditions may not be suitable for such an exercise for several days.

28. CONCLUSIONS

1. Finding a balance between having effective training and accommodating the risks that can be associated with realistic training is a challenge for the offshore oil industry but there should be a greater acceptance of training risks thereby acknowledging the fact that it is better to take these risks under the controlled environment of training rather than have accidents during a real life scenario.

2. That training ships should be considered as a way of extending training to more realistic situations and providing effective training in launch and recovery.

3. That detail improvements in launch and recovery systems and in the out-fitting of the FRCs could lead to significant improvements in both the effectiveness and safety of the operation of FRCs. In this report there are a number of aspects detailed that can lead to improved safety and effectiveness and most of these can be introduced on a piecemeal basis.

4. That tighter regulation of the parameters associated with FRCs and their launch and recovery systems is not the best way to create improved systems and it could have a negative effect on development. Improvements should be on a voluntary basis but this does require a motivation to want to improve systems.

5. The requirements for improved systems for the launch and recovery of daughter craft has tended to take the focus away from the requirements of FRCs and there is a need for research and development funding in areas where the commercial benefits may be relatively small and commercial research is not justified.

6. Whilst small modifications to improve the launch and recovery systems and the FRCs themselves are within the capability of the vessel operators it is felt that the oil companies or 'duty holders' should take the initiative to require more costly changes that could significantly improve the operational capability. This could apply to developments such as a stern launch and recovery system and these are only going to be introduced if the duty holder demands them and is prepared to increase charter rates to pay for them.

7. It is considered that only making changes when replacement is due could lead to a prolonged time span for change. FRCs and their davits may only be replaced every 15 or 20 years when the ship itself may also become redundant. Therefore some form of incentive scheme for introducing improvements should be considered so that the cost of replacing an FRC or its launch and recovery system can be achieved before the item is retired through old age.

Printed and published by the Health and Safety Executive
C0.06 07/05

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ISBN 0-7176-6148-2

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