Intuitive operation and pilot training when using marine azimuthing control devices

AZIPILOT

Report Title:	Task Report
Work Package:	MARITIME TRAINING
Task Number:	3.9
Task Title	Integrate knowledge by recommending training programs
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Partners Code:	CONS, FORC, PRL, TYNE, UNEW
Document Type:	Task Report
Document status:	CO - Confidential

31st October 2011	Draft
3rd November 2011	Draft Final
17th November 2011	Approved

Contents

1 Publishable Executive Summary

The aim of this task is to encapsulate the knowledge gained from other tasks including training needs and requirements relating to Azimuthing Control Devices (ACD's). This will be achieved by cross referencing the findings for existing training programmes and their limitations and the specific needs of new and young personnel. With this knowledge and the cross fertilisation of real-time exercises conducted on both numerical simulators and physical scale-models, the objective will be to make recommendations to the industry as to the scope and content of training modules for Ships Officers and Marine Pilots employed on vessel fitted with ACD's; to ensure personnel are suitably equipped to counter both normal and emergency scenarios.

The objective of this task is to compiling the main project outcomes into a form that is readily exploitable for use in maritime pilot training and the wider maritime industry. Specifically, the STCW95 (Standards for Training, Certification and Watch-keeping) code regulates the required competences for all ships operators. According to the STCW95 code, ship masters and chief officers functioning at management level onboard ships more than 500 GT shall possess very specific competences including 'be able to respond to navigational emergencies' and 'manoeuvre and handle a ship in all conditions'

2 Introduction

This report should be read in conjunction with *Deliverable 4.8: Recommendations to improve current operational practice*.

3 Feedback for industry needs from academic education.

Maritime research and training academies (Institutes), such as FORCE Technology in Denmark rely very much on high class professionals educated and trained as Naval Architects, Engineers or Ship Masters.

Interviews with Naval Architects, Engineers and their superiors at FORCE Technology gave the general impression that the academic education was perceived as being of a very high standard. A majority, however, pointed out that in relation to the daily tasks and routines they would have benefitted from having been educated to a higher level of knowledge and proficiency in:

- Writing a professional report;
- Language skills (predominantly English), spoken and written;
- Quality assurance. Including the quality of our products (data);
- Knowledge of the maritime environment. E.g. different vessels and offshore installations operation and management;
- Measuring techniques and calculations;
- Electronics – comprehension of equipment used in the test facilities;
- A more profound understanding of data signal processing in connection with measurements and calculations.

The Ship Masters said that their academic education gives the very basic theoretical knowledge of hydrodynamics and ship handling but the skills needed to be a maritime simulator instructor and navigational advisor comes from seagoing experience combined with further academic education in:

- Vocational teaching;
- Psychology – human factors;
- Hydro- and aero-dynamics.

4 Feedback for operational need from training

4.1 Task 3.1

Training requires cooperation with ship owners. Unfortunately, pressure on some ship owners is shortening the training time available for their operators. Consequently this is resulting in a direct increase in the number of human errors committed.

In particular, the need for an operator to know how their ACD vessel is going to respond in different scenarios is essential. Knowing how the ACD vessel is going to respond to orders, depends upon knowing how the various operating modes can apply restrictions to that control. Different operating modes have different terminologies amongst various operators, depending on the manufacturer/operator. These modes can also work in slightly different ways. These facts emphasize the importance of universally accepted and specific terminology/definitions, and also the need for accurate simulation models of the particular vessel that is to be handled.

The training of operators on ACD vessels ideally needs to be done on a simulated model of the vessel(s) they are expected to operate and with identical controls.

4.2 Task 3.2

Amongst other causes of accidents at sea, casualties related to manoeuvrability happen quite often and CRG (Collision-Ramming-Grounding) casualties constitutes about 53% of all serious accidents leading to ship loss. CRG casualties occur more often with increased speed and size of vessel and also in restricted waterways and canals (in particular where external factors, make handling of ships more difficult e.g. currents, wind, interaction).

The reduction of the number of casualties, in particular CRG, is one of the main objectives of IMO. Basic training in ship handling is required by STCW; however, how these competencies are acquired is not transparent.

Escort tugs are almost always fitted with azimuthing propellers and an escorting operation, especially in case of emergency, requires greater skill from the tug masters and ship masters/pilots.

A 1995 report from US Coast Guard revealed that 80% of the CRG accidents are caused by human failure, in most of the cases on ships equipped with the most modern navigational aids and bridge systems.

Human errors can be classified as follows:

- Communications (transmission of information);
- Planning & preparation (program, procedures, readiness);
- Slips (accidental lapses);
- Selection & training (suited, educated, practiced);
- Violations (infringement, transgression);
- Limitation & impairment (fatigue, stress, diminished senses);
- Ignorance (unawareness, unlearned);
- Mistakes (cognitive errors).

Appropriate training can address the above issues, in particular in emergency and critical situations, bringing benefits to overall safety.

The use of FMBS or MMS are methods approved by STCW (Table A-II/2) as methods to demonstrate competence, as well as, approved in-service experience, as they allow the trainee to face with some critical situations that he would probably not experience during his training period onboard. Whilst standards can be monitored in FMBS and MMS, approved in-service experience is far from transparent and a potential weak link in assuring that candidates acquire the appropriate competencies.

4.3 Task 3.3

Azimuthing Stern Drive (ASD) tug handling is complex and very demanding to the master or mate operating the controls. Even when experienced and trained the manoeuvring of the tug quickly comes close to the limit of human capabilities. It confirms the importance of theoretical and practical education and training in a simulator as well as on board the tugs. The right training, education and experience enhances the possibility of the master being able to pull the right “schemata” from his memory in a dynamic and fast changing situation in order for him to make the right decisions swiftly and perform the right actions promptly and intuitively. If he is not able to do this, then the tug operation will not be safe or efficient. However, STCW in general relates to vessels greater than 500 GT and most tugs are less than 500 GT and are not covered by the main STCW regulations. However, there are training requirements in Table A-II/3 that apply but of a lower competency.

Through some interviews conducted with experienced people operating ACD’s it highlighted that it would be of great benefit for simulators to exhibit ‘realism’ through sound, sight and feel as in the ‘real’ world. It is considered to be important that the controls and console in the simulator correspond to the ones the operator finds on his/her real ship (especially for tugs). Unfortunately there is a large variety of controls and consoles to be found on tugs and it is impossible for simulators to have every type available.

4.4 Task 3.5

In many districts escorting of large vessels carrying dangerous goods is required. Escort tugs are almost always fitted with azimuthing propellers and escorting operations, especially in case of an emergency requires greater skill from the tug master and ship masters/pilots. Training in escorting operation is a developing area where additional special training is also necessary. With the differing manoeuvring characteristics that ACD fitted vessels display, it is important that prospective ship masters and pilots are aware of these unusual handling characteristics, especially when operated in:

- Shallow water areas;
- In shallow water with muddy bottom;
- Deep and shallow water areas of restricted dimensions, such as harbour basins and similar areas;
- Restricted waterways, such as narrow channels and ship canals (feeling canal effect);
- In close proximity of banks (feeling bank or wall effect);
- In close proximity of other ships, either moving or at rest;
- In areas where currents are encountered, which may be cross currents or vary with depth;
- Berthing and unberthing alongside piers and jetties of different construction (on open piles or a solid quay wall) in various depths.

The training courses on simulators should include these effects in their respective programmes. It is acknowledged that FBMS, and the complexity of mathematical modelling formulae that interrelate with one another, renders them to some errors when dealing with Interaction and Squat exercises. Scaled Manned Models are less likely to have these errors, although having the lake profile at exactly the tolerances required can be difficult to achieve and maintain. To avoid excessive wear and/or damage to bearings, many manufacturers impose numerous limitations upon the operation of ACD's. Generally, recommendations made by the manufacturer are as follows:

- Operate pods as gently as possible
- Avoid reverse power (reverse rpm)
- Maintain positive rpm
- Crash stop to be avoided
- Avoid wash onto another pod(s)
- Avoid applying large angles of rotation
- Maintain minimum revolutions
- Avoid large differences between rpm and ship speed
- Avoid unpowered rotation at low speed
- Avoid powered rotation below 25 rpm and preferably 30 rpm
- Avoid cycling between zero 25 to 39 rpm
- Avoid cycling between forward and reverse rpm
- Avoid wash over unpowered pod
- Avoid flow from a pod directly entering the propeller of the other pod

The operation of pod driven ships is not straightforward and quite different to conventional ships and the limitations above, requires specific strategies to be employed, not only to avoid expensive damage to the pod(s) but to gain maximum efficiency from this type of equipment. These features are an important aspect of any simulator training. Developing appropriate strategies to encompass these limitations is an important part of any simulator training programme, which cannot be guaranteed by on-board experience alone.

4.5 Task 3.6

The opinion of the majority of pilots interviewed during the project declared that ACD's training is necessary and many of them are of the opinion that a 5 day simulator course on ACD ships is the optimum solution. A great number of pilots and ship masters interviewed also expressed the opinion that there is the need for arranging specific specialised training courses on ships equipped with ACD's, in particular in order to enhance their knowledge and skill in handling these particular ships in a safe and intuitive manner, especially in varying critical situations. It is envisaged that basic shiphandling training, as per STCW, should be a precursor to this type of specialised training. This outcome would improve safety for vessel equipped with ACD's both at sea and also in port, especially during berthing/unberthing operations.

When compared to conventional shiphandling, a trained and experienced shiphandler will find controlling ACD's quite different from any past experiences. The restrictions listed above, if adhered to, add another level of complexity as well. Hence, the importance of developed operational procedures, combined with specialist training, to ensure that ACD's are operated efficiently and safely. In this project, we have met trained shiphandlers who operate to set procedures and have gone on and gained vast experience, who are a joy to watch. On the other hand, we have met untrained shiphandlers who are a great cause for concern and many others, somewhere in between, desperately struggling to control their vessels and failing to get the optimum use from this type of propulsion.

Without good operational procedures, mistakes can easily be made which can be very costly and unsafe. Whilst some companies have developed excellent procedures, these can vary from company to company and for pilots this is of great concern as there is not a ‘uniform industry’ approach. This can vary from the pilot being excluded from conning the vessel, to terminology that can be, at best confusing. On vessels where no operational procedures exist the command structure can be severely compromised. Whilst shiphandling, when things start to go wrong, due to a large gust of wind or an equipment failure, things tend to go wrong extremely quickly. Hence, the need for good operational procedures and appropriate specialist training, as the foundations on which experience can be built.

4.6 Task 4.2

Training courses are required to give any new operators the correct theory as to how and why ACD’s work. The starting point is a basic shiphandling course, to comply with current STCW regulations, and because ACD’s are quite different to operate than traditional ships a separate specialist training course is essential. This is one of the main reasons why appropriate specialist training is needed prior to going onto a ACD ship.

A survey performed by PRL reveals that most of the respondents to the questionnaire consider it quite important that the equipment used during training is the same system as on the ship.

The PRL survey also collected a list of ideal aims that, according to the respondents, any specialist training course for ACD’s should encompass:

- Practical exercises with ‘hands on’ use
- Many types of ACD’s – result can be achieved by different means
- Principles and Theory (pulling, pushing) of ACD’s
- Limitations of use and strategies to overcome these limitations
- Emergency scenarios

4.7 Task 4.3

A survey of accidents onboard ships with ACD’s shows that, despite considerable experience at sea, there is a need for adopting appropriate operational procedures and undergoing specialist training. Task 4.3 highlighted that a number of past accidents have occurred when changing control from a central bridge console to a bridge wing console. We have noted that apart from good operational procedures, where the design has utilised synchronised controls, this simplifies the procedure and there is much less chance of error.

A standardised set of verbal instructions was identified in Task 4.4 (Baken and Burkley “Azipod Manoeuvring Terminology” (March 2008)) that may in some circumstances promote a clear and concise methodology to control ACD’s. However, generally the control of ACD’s tends to be a tactile ‘hands on’ practice and giving verbal commands in a multi unit system would be prone to errors, especially in the translation and a maybe a rather rigid method of using this type of versatile propulsion control. We would contend that ACD's are a departure from conventional propulsion systems, which historically have been operated by verbal commands. Current practise with Controllable Pitch Propellers (CPP) and bow thrusters, especially with twin screw configurations, already lends itself to a 'hands on' approach and a departure from historical verbal commands. ACD's simply take this another step further and do not need any historical baggage of 'verbal commands'. However, it is recognised that any 'hands on' approach does have a tendency for a single point error, that may not be picked up by other members of a 'bridge team' and we would recommend this an area of further research. A pilot of an aircraft has always operated with a 'hands on' approach and has never used verbal commands but is supported by strong procedures and often a co-pilot.

We have also noted that the above terminology when applied to Azipods (pulling pods), if also applied to pushing pods, has quite different results. Hence, pilots in particular, could be confused by this, if they fail to comprehend (or it is not explained) whether a pod is pulling or pushing. We therefore recommend that further work is required and suggest that 'result orientated' commands (if verbal commands are used at all) may well be a better approach.

Another area that we have discovered that causes confusion are the terms 'OUTWARD' and 'INWARD', and suggest that further research be conducted to establish a method of terminology that is not open to differing interpretation. ABB define 'outward' as 'turning the propeller end outwards', which is specific to pulling pods, as the result, if this definition is applied to pulling pods, is quite different. When using multiple pulling ACD's, it is better to tactically operate the device using 'positive thrust'. This is generally a better strategy that addresses the manufacturer's limitations, as well as, recognising the loss of power efficiency resulting from reversing the pitch could be as much as 60%. This loss of efficiency is caused by the flow of water entering the propeller being disturbed by the pod body, as well as, by the propeller design. So, it is desirable to maintain 'positive thrust' and turn the pod, changing its direction, instead of reversing the pitch. This can be achieved in multi pod arrangements by 'vectoring' the pods to achieve desired results. This strategy also helps to avoiding cycling between zero and 25 rpm, trying to maintain a 25 rpm speed at all times, avoiding a large difference between rpm and ship speed.

Avoiding direct wash from one unit directly into another and also avoiding water flow from one unit entering the propeller of the other unit, can also be best achieved by a strategy of directing 'positive thrust' water flow away from the hull. Thus a neutral effect can be achieved by using 'positive thrust' from two pods being directed away from the hull, in opposite directions, which forms the starting point of varying power and direction (vectoring) to achieve shiphandling aims, as opposed to the simplistic 'T-bone' method, (one unit fore and aft, the other operated transversely) which does not utilise the azimuthing function of ACD's to best effect and is contrary to the operational limitations imposed by the manufacturers.

5 Recommendations for simulator and manned model based training programs

In 1978, IMO created The International Convention on Standards, Training, Certification and Watchkeeping for Seafarers (STCW). This came into force in 1984 and was significantly amended in 1995.

The 1978 STCW Convention was the first to establish basic requirements of Standards, Training, Certification and Watchkeeping for seafarers on an international level. By December 2000, the STCW Convention covered 135 Parties, representing 97.53 percent of world shipping tonnage. STCW95 introduced concepts to address the problem of Human Error. The most significant changes concerned:

a. enhancement of port state control
b. communication of information to IMO to allow for mutual oversight and consistency in application of standards
c. quality standards systems (QSS), oversight of training, assessment, and certification procedures
d. placement of responsibility on parties, including those issuing licenses, and flag states employing foreign nationals, to ensure seafarers meet objective standards of competence, and
e. rest period requirements for watch-keeping personnel

These amendments entered into force on February 1, 1997. Full implementation was required by February 1, 2002. There are currently STCW10 amendments that are due to come into force on 1st January 2012 (‘Manila Amendments’). STCW also requires all training and assessment activities to be "continuously monitored through a quality standards system to ensure achievement of defined objectives, including those concerning the qualifications and experience of instructors and assessors." Persons performing these roles are expected to have received guidance in instructional techniques and assessment methods.

5.1 Analysis of STCW with regard to shiphandling training

The full code runs to 346 pages and it is quite difficult to read through and reference exactly what and where any requirements may be.

OFFICERS

In (Annex Chapter II) Table A-II/1 (page 27) a *‘Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more’* can be found.

It outlines *‘Function: Navigation at the operational level’* and one of the competencies is *‘Manoeuvre the Ship’* (Page 35).

MASTERS

In (Annex Chapter II) Table A-II/2 (page 42) a *‘Specification of minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more’* can be found.

It outlines *‘Function: Navigation at the management level’* and one of the competencies is *‘Manoeuvre and handle a ship in all conditions’* (Page 48).

TUGS

In (Annex Chapter II) Table A-II/3 (page 60) a *'Specification of minimum standard of competence for officers in charge of a navigational watch and for Masters on ships of less than 500 gross tonnage engaged on near-coastal voyages'* can be found.

It outlines *'Function: Navigation at the operational level'* and one of the competencies is *'Manoeuvre the ship and operate small ship power plants'* (Page 65).

PILOTS

Pilots are not covered by STCW95 although Resolution 10 invites IMO to consider developing provisions covering the training and certification of maritime pilots.

However, pilots are covered by the provisions of **IMO Resolution A960 (23)** (Recommendations on training and certification and operational procedures for Maritime Pilots other than Deep-Sea Pilots)

> *Annex 1 - 7.1.18:* manoeuvring behaviour of the types of ships expected to be piloted and the limitations imposed by particular propulsion and steering systems;

5.2 PILOT TRAINING - ETCS (Education, Training and Certification Standards)

ETCS was developed some years ago in Europe as a template for Maritime Pilots and some European countries have or are currently in the process of embracing these standards. There is a current international weakness in ensuring that all pilots are trained to an International Standard. There are numerous national and international codes and recommendations but little, if anything, is mandatory. STCW95 resolution 10 invites IMO to consider developing provisions covering the training and certification of maritime pilots and we would commend ETCS as an appropriate template to take this forward to be developed, whereby provision for ACD training for pilots could be made.

5.3 ISM Code

"6.3 The company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarisation with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given."

5.4 IMO Model Course 7.01 MASTER AND CHIEF MATE (1999 Edition)

"1.9 Manoeuvre and Handle a Ship in all conditions" (Page 32-33 are guidance notes, Pages 74 – 81 lists 15 subject areas and details the various competencies:

1. Approaching A Pilot Vessel (4 hours)
2. Ship Handling in Restricted Waters (10 hours)
3. Constant Rate of Turn Techniques (1 hour)
4. Manoeuvring in Shallow Water (2 hours)
5. Interaction: Bank, Canal, Ship and Tug (2 hours)

6. Berthing and Unberthing (12 hours)
7. Use of Propulsion and Manoeuvring Systems (1hour)
8. Anchoring (6 hours)
9. Dry-Docking (2 hours)
10. Handling Ships in Heavy Weather (6 hours)
11. Rescue Boats and Survival Craft (2 hours)
12. Manoeuvring and Propulsion Characteristics (3 hours)
13. Damage due to Own Ship's Bow and Stern Waves (1 hour)
14. Navigating In Or Near Ice (3 hours)
15. Manoeuvring in TSS and VTS (2 hours)

A total of 57 hours tuition.

5.5 SHIPHANDLING TRAINING

In STCW (Annex Chapter II) Table A-II/2 (page 48) column 2 lists 18 scenarios of '*Knowledge, understanding and proficiency*' and column 3 lists 3 *'Methods for demonstrating competence'*. Examination and assessment of evidence obtained from one or more of the following:

1. Approved in-service experience
2. Approved simulator training, where appropriate
3. Approved manned scale ship model, where appropriate

Recommended specialist training for ACD's

There is nothing in the Code that is specific to training on ACD's. However, some parts could be interpreted as such. This is unsatisfactory, as experience has shown that the 'good operators' do take up appropriate training, whilst many do not. It is recommended that a specific specialist training regime should be added to the Code for ACD vessels.

In theory, everyone with a STCW95 certificate should have met the shiphandling requirements listed in the above tables. Experience shows that whilst some shipping companies have met and followed this standard, sadly many have not. Asking why is beyond the scope of this report, but it is a very interesting question nevertheless. Practically, it is very difficult to monitor standards of 'Approved in-service experience', whereas this is easier to achieve with FMBS and MMS.

5.6 LARGE SHIPS and ships with UNUSUAL MANOEUVERING CHARACTERISTICS

IMO STCW Annex Chapter 5 Section B-V/a (Page 255) stipulates;

> '*Guidance regarding additional training for masters and chief mates of large ships and ships with unusual manoeuvring characteristics'*

It should be construed that ACD's fit into this category, however this is open to some degree of interpretation and a recommendation would be for the Code to be specific with regard to ACD's.

2 Prior to their appointment to such a ship, masters and chief mates should:

.1 be informed of the ship's handling characteristics by the company, particularly in relation to the knowledge, understanding and proficiency listed under ship manoeuvring and handling in column 2 of table A-II/1 – Specification of the minimum standard of competence for masters and chief mates of ships of 500 gross tonnage or more; and

.2 be made thoroughly familiar with the use of all navigational and manoeuvring aids fitted in the ship concerned, including their capabilities and limitations.

3 Before initially assuming command of one of the ships referred to above, the prospective master should have sufficient and appropriate general experience as master or chief mate, and either:

.1 have sufficient and appropriate experience manoeuvring the same ship under supervision or in manoeuvring a ship having similar manoeuvring characteristics; or

.2 have attended an approved ship handing simulator course on an installation capable of simulating the manoeuvring characteristics of such a ship.

Hence, it can again be seen that the regulations are reasonably clear that operators of ACD's should have received appropriate training, but experience shows that as this is only a recommendation then this is not always the case. There are other parts of the Code that also refer to how that training should be delivered:

ANNEX CHAPTER 1 Regulation I/12 *Use of simulators* (page 31)

Annex 1 Part A Section A- I/12 *Standards governing the use of Simulators* (page 20)

ANNEX CHAPTER 1 Regulation I/14 *Responsibilities of companies* (page 33)

Annex 1 Part A Section A- I/14 *Responsibilities of Companies* (page 24)

6 Recommendation of a framework for Simulator and Manned-model based Training Programs

STCW95 and ISM Code 2002 (Appendix D) puts the responsibility on the ship-owner to ensure that the crew on their vessels are competent to carry out the duties they are expected to perform.

6.1 Basic Shiphandling Course

Our studies within the project indicate that training for ACD's is necessary and operators are keen to embrace such training. However, before specialist ACD's training can be specified, we have to assume a basic level of competence in shiphandling first. Hence, candidates should have attended a basic shiphandling course prior to embarking on a specialist ACD course.

There is a difficulty here, in that the standard for a basic course has not been universally set, although Table A-II/1 and Table A-II/2 could form the basis of such a standard from which a IMO Model Course could be developed. Also DNV have developed a range of training standards and one could be developed for a basic shiphandling course and also a specialist ACD's course, which might form the basis for an IMO Model Course in the future. This would be desirable due to the long lead in times at IMO to bring about change.

The 18 points below are the contents of column 2 in Table A-II/2 and it ought to be assumed that a basic course would cover all these points:

1. manoeuvres when approaching pilot stations and embarking or disembarking pilots, with due regard to headreach and stopping distances
2. **handling ships in rivers, estuaries and restricted waters, having regard to the effects of current, wind and restricted water on helm response**
3. **application of constant rate of turn techniques**
4. **manoeuvre in shallow water, including the reduction in under-keel clearance caused by squat, rolling and pitching**
5. **interaction between passing ships and between own ship and nearby banks (canal effect)**
6. **berthing and unberthing under various conditions of wind, tide and current with and without tugs**
7. **ship and tug interactions**
8. **use of propulsion and manoeuvring systems**
9. choice of anchorage; anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used
10. dragging anchors; clearing fouled anchors
11. dry docking, both with and without damage

12. management and handling of ships in heavy weather, including assisting a ship or aircraft in distress; towing operations; means of keeping an unmanageable ship out o trough of the sea, lessening drift and use of oil

13. precautions in manoeuvring to launch rescue boats of survival craft in bad weather

14. methods of taking on board survivors from rescue boats and survival craft

15. **ability to determine the manoeuvring and propulsion characteristics of common types of ships with special reference to stopping distances and turning circles at various draughts and speeds**

16. **importance of navigating at reduced speed to avoid damage caused by own ship's bow wave and stern wave**

17. practical measures to be taken when navigating in or near ice or in conditions of ice accumulation on board

18. use of, and manoeuvring in and near, traffic separation schemes and in vessel traffic service (VTS) areas

The sections highlighted in bold (2-8 & 15-16) cover the type of exercises that can normally be done on FMBS and MMS.

6.2 Specialist ACD Course

Once we have established at what level a candidate has attained, i.e. an entry level, we can gauge the starting point for a specialist course and develop the course content to deliver a 'generic training course for ACD's' which would satisfy a level of competence and also a 'type specific training course', which is often provided by equipment manufacturers.

It is necessary to stress that experience in conducting training courses shows the need for flexibility in arranging course programmes, because in many cases programmes should be tailored to meet the particular requirements of the Pilots' organizations, ship owners and tug companies, whilst also meeting a recognised standard of competence. Customer specific training is very popular and provides training on demand. Usually Senior Mariners, Pilots and Tug Captains come back to FMBS to improve their abilities in manoeuvring ACD ships, and to keep up-to-date with any changes in harbour environments, different ship types or ACD control systems.

Specialist ACD training delivered by either FMBS or MMS should follow the same fundamental principles of training;

- Revision of theory of shiphandling principles
- Special points/limitations on FMBS and MMS to deliver training
- Generic Training and/or Type Specific Training
- Principles and Theory (pulling, pushing) of ACD's
- Limitations of use and strategies to overcome these limitations
- Many types of ACD's – result can be achieved by different means

- Operational procedures
- Different terminologies currently used and result oriented terminologies
- Series of practical exercises with ‘hands on’ use
- Towing for ACD’s
- Towing by ACD’s
- Escort Towing
- Emergency scenarios

Each topic can be broken down further, depending on the type of simulator to be used and addressing the needs of delegates i.e. ship master, pilot or tug operator.

A longer term objective in handling ACD’s is to do it ‘without thinking’, where ‘it is just natural’ for a properly trained and experienced Ship handler. i.e. Safe and intuitive. See Captain Arnolf Remo’s comments (Senior Master, Independence of the Seas).

6.3 Summary of Recommendations

- The STCW code Table A-II/2 – is amended to reflect a specific mandatory requirement for training with ACD’s and any other unusual or extraordinary manoeuvring devices;

- Table A-II/2 column 3 *‘Methods for demonstrating competence’* that ‘Examination and assessment of evidence obtained’ from ‘*Approved in-service experience’* is removed;

- The STCW code Section B-V/3 is amended accordingly;

- An specific IMO Model Course for Basic Ship Handling and also a specialist ACD’s Ship Handling Course is developed;

- The IMO Resolution A960(25) is amended with a paragraph detailing knowledge of and training in the manoeuvring of ACD’s or other unusual or extraordinary manoeuvring devices;

- STCW95 Resolution 10 invites IMO to consider developing provisions covering the training and certification of maritime pilots, and we recommend that this should be done to encompass mandatory training in ACD’s for pilots. (ETCS - Education, Training and Certification Standards - has already been developed in Europe and this would provide a suitable model for the certification and training of maritime pilots).