Intuitive operation and pilot training when using marine azimuthing control devices

AZIPILOT

Report Title:

Deliverable 3.1:

Review of training needs and available training for azimuth devices

Contents

EXECUTIVE SUMMARY

The present report contains the main results of Task 3.1 of the AZIPILOT Project.
WP3 of the project is specifically addressed to maritime pilots, ship operators/managers, pilot associations and end users. More generally it is aiming at subjects related to training with azimuthing control devices (ACD).
The main aim of WP3 is to collate, review and audit available material that is relevant to the subject of Maritime Training; specifically for ships equipped with ACD's when manoeuvring ships in pilotage waters. The outcomes of the work will be used to improve current techniques and tools, also with involvement of the dedicated Authorities and Regulatory Bodies.

The aim of the task is to review training needs and requirements specifically for ships equipped with ACD's.
Training requires collaboration with ship owners. Unfortunately, pressure on some ship owners is shortening the training time 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 vessel is going to respond in different scenarios is essential. Knowing how the vessel is going to respond to orders depends upon knowing how the various operating modes apply restrictions to the control. Different operating modes have different terminologies, depending on the manufacturer. They can also work in slightly different ways. These facts emphasise the importance of universally accepted specific terminology and definitions, and also the need for accurate models of the particular vessel that is to be handled.

> *Ideally, shiphandling training should consist of training on the real ships (with limitations due to available time and acceptable risk level), on the simulators (with limitations due to accuracy of mathematical models of ships and hydraulics) and on the manned models (with limitations due to vision and wind).*

Training available (in 2010) for ACD's using Full-Mission-Bridge-Simulation Methods, desktop Simulation Methods and Manned Model techniques are reviewed:

- Full-Mission-Bridge-Simulation:
  - MITAGS, Maritime Institute of Technology & Graduate Studies, Maryland, USA
  - STAR CENTER, Dania Beach, Florida, USA
  - MARITIME SIMULATION AND RESOURCE CENTRE, Québec, Canada
  - ABB Marine Academy, Finland
  - CSMART, Centre for Simulator Maritime Training, owned by Carnival, The Netherlands
  - STC B.V., Centre for Simulator Maritime Research & Training owned by STC Group, Rotterdam, The Netherlands
  - FORCE Technology, Denmark
  - SOUTH TYNESIDE COLLEGE, UK
  - MARIN, The Netherlands
- Manned Models:
  - PORT REVEL, France
  - ILAWA, Poland

The work summarized in this deliverable has been conducted by Port Revel, Broström, Force Technology and South Tyneside College.

1. CONTRACTUAL TASK DESCRIPTION

Task 3.1	**Review training needs & requirements for azimuth devices.**						
Start Month:	0					**Duration (months):**	18
Participating partners:	PRL	BSM	FORC	TYNE			
Person-months:	0.2	0.8	0.3	1			

The aim of the task is to review training needs and requirements specifically for ships equipped with azimuthing control devices. The objective is to benchmark the state-of-the-art and in doing so, map out its limitations. The main areas of focus will include:

- Review specific training needs on ships equipped with azimuthing control devices.
- Review specific training available using Full-Mission-Bridge-Simulation Methods.

[TYNE; BSM]

- Review specific training available using desktop Simulation Methods.

[FORC; BSM]

- Review specific training available using Manned-Model techniques.
- Compile list of subject specific terminology and definitions.

[PRL;BSM]

The task will culminate in a task report that will delineate the above aims and objectives and will constitute one deliverable.

[PRL]

2. TRAINING NEEDS

There certainly is a need to train the crews prior to start using this equipment "in real life". The ACD concept is a very basic way of manoeuvring a vessel, but at the same time it is different from the "usual" way of manoeuvring. So, yes, there is a need for training.

- **Data Collection Source.**

In order to perform an analysis for the objectives set out in the relative Work Packages, it was collectively decided, during the progress of Phase 1, that any questionnaires the different Work Packages produced, should be collated, and distributed to the appropriate organisation. A repository of these organisations/companies was produced, and can be found on the Azipilot Website, entitled "Basic Groups of Interest."
The reasoning behind this method of questionnaire distribution includes:

- It was considered that a higher yield of completed returns would result, due to the fact that the targeted organisations would receive one questionnaire.
- Organisation and administration would be simplified.
- The Organisation Repository would be useful for all Work Package Partners.

- **Composition and rationale of the Questionnaire.**

The primary objectives of the questionnaire were:

- Review specific training needs on ships equipped with azimuthing control devices.
- To determine what training is available using Full Mission Bridge Simulation methods.

The questionnaire itself can be found in Work Package 2.
Specific details of areas that are important to particular shipping companies with respect to azimuthing controlled device vessels are an outcome of this questionnaire, the results of which can be correlated with response from training facilities.

- **General review of training needs and requirements on ships.**

The objective of this section is to give the reader an idea of how training is organised within simulator training facilities, and then in the next section, to develop this organised training specifically respecting azimuthing controlled devices.
The Standards of Training, Certification and Watchkeeping (STCW), as published by the IMO, details standards of training that are required by law for vessels whose Flag State have signed up to the Safety Of Life At Sea (SOLAS) convention.
The IMO publish various Model Courses, which are recommendations of course content that training facilities may wish to include in their curriculum, in order to meet the STCW. An example would be Model Course 1.22 "Ship Simulators and Bridge Teamwork".
Different training facilities have varying course content, which indicates how that particular facility considers a course will achieve the best outcome. The course content is influenced by, amongst other matters, the training staff's experience and what their client's requirements are.
Section A-I/12 Part 2 of STCW supplies criteria for simulator training, objectives and assessment. This specifies a basis for training courses on a general basis. STCW, Section B-I/12 provides guidance regarding the use of simulators employed in training. Paragraph 2[1] reads as follows:
Each party shall ensure that any simulator used for the assessment of competence required under the Convention or for any demonstration of continued proficiency so required shall:

1. *be capable of satisfying the specified assessment objectives;*
2. *be capable of simulating the operational capabilities of the shipboard equipment concerned to a level of physical realism appropriate to the assessment objectives, and include the capabilities, limitations and possible errors of such equipment;*
3. *have sufficient behavioural realism to allow a candidate to exhibit the skills appropriate to the assessment objectives;*
4. *provide an interface through which a candidate can interact with the equipment and simulated environment;*
5. *provide a controlled operating environment, capable of producing a variety of conditions, which may include emergency, hazardous or unusual situations relative to assessment objectives; and*
6. *permit an assessor to control, monitor and record exercises for the effective assessment of the performance candidates.*

Paragraph 38[2] reads as follows:
In addition to meeting the performance standards set out in paragraph 37[3], ship handling simulation equipment should:

1. *provide a realistic visual scenario as seen from the bridge by day and by night with variable visibility throughout a minimum horizontal field of view available to the trainee in viewing sectors appropriate to the ship handling and manoeuvring training tasks and objectives; and*
2. *realistically simulate 'own ship' dynamics in restricted waterways, including shallow water and bank effects.*

Thus, it can be seen that the STCW provides needs and requirements not only for course content, but also needs for simulator standards. The Classification Society Det Norske Veritas (DNV) has produced class notations and designations for simulators to ensure that simulators

[1] General performance standards for simulators used in assessment of competence.
[2] Recommended performance standards for non-mandatory types of simulation. (Ship handling and manoeuvring simulation.)
[3] Navigation and watchkeeping simulation.

complying with their standards meet the requirements of STCW. Various other organisations also offer formal approval of simulators as a means of satisfying their particular niche in the industry. These include the Maritime Coastguard Agency and the Norwegian Maritime Directorate.
Training needs, therefore, require simulators that meet the appropriate standards.
Under STCW, a Full Mission Bridge Simulator is classed as Category 1: "Capable of simulating a total environment, including capability for advanced manoeuvring and pilotage training in restricted waterways." (This implies an interactive instructor facility connected to a fully equipped ship's bridge with high quality visuals, sophisticated mathematical ship and environment models, a sound system, numerous playing areas, multiple own and target ship models and possibly a motion system)[4].
At present, even if the simulators used in training meet the appropriate standards, it does not ensure the models used on the simulator handle realistically, and this appears to be a shortcoming. This can be attributed to a number of factors, the most predominate one being that, when a model for a vessel is being developed for use on a simulator, extremely detailed information is needed about the real vessel. This information is usually exceedingly difficult to obtain, due to the fact that it is confidential. After the model has been developed with the information that is available, it is then rigorously tweaked and tested. This tweaking however is not usually how the mathematical algorithms in the software are intended, or designed to be used, leading occasionally to unexpected results.
Organisations like the North Sea Safety Forum also make recommendations to the training needs for courses, and have assessment criteria that need to be met on approved training programmes.

- **Review of specific training needs on ships equipped with azimuthing control devices.**

There appears to be no specific requirements concerning training on azimuthing controlled device (ACD) vessels, as long as the training meets the standards mentioned in the previous section.
Generic training courses on ACD vessels may not meet the needs of the operator. This is due to the many different ways ACD vessels can be configured. Each of these different configurations and technologies has its own unique handling characteristics. Thus the training of operators on ACD vessels needs to be done on simulated models of their real vessels. The previous section highlights difficulties encountered with this.
Training, therefore, especially on ACD vessels, requires collaboration with ship owners. Unfortunately, pressure on some ship owners is shortening the training time for their operators. Consequently, this is resulting in a direct increase in the number of human errors committed[5].
In particular, the need for an operator to know how their vessel is going to respond in different scenarios is essential. Knowing how the vessel is going to respond to orders depends upon knowing how the various operating modes apply restrictions to the control. Different operating modes have different terminologies, depending on the manufacturer. They can also work in slightly different ways. These facts emphases the importance of universally accepted terminology, and also the need for accurate simulator models of the particular vessel that is to be handled.

3. TRAINING AVAILABLE ON FULL-MISSION BRIDGE SIMULATORS

There are many training simulators around the world. Demand for ACD training is smaller than for traditional ships, so it is believed that if a number of the existing simulators would include ACD's in their training programs, the demand for training would be easily met.

A condensed list of typical course titles and their content that specifically relates to ACD vessels is given below (based on information provided on their web sites, in the case of STC based on

[4] NHL Hogeschool Knowledge Centre.
[5] "Simulator training versus sea time" Maritime Simulation News, November 2009

information submitted by STC). As can be seen, several courses that directly relate to azimuthing devices are tug handling courses. Generic ship handling courses do not tend to emphasise training for azimuthing devices.
Azimuthing device specific courses are geared towards whatever the training facility can provide. Usually, the facilities have generic propulsion units and control levers. Some facilities provide a more specialised service, for example dedicated to Azipod Propulsion units, with Kamewa control systems. These more dedicated facilities are usually owned by the equipment manufacturer, like ABB.

Name of Training Facility	Course Title	Duration (days)	Description
MITAGS Maritime Institute of Technology & Graduate Studies Maryland, USA	Azipod/Kamewa	3	The Azipod/Kamewa orientation course is designed to familiarise the attendee with the unique manoeuvring characteristics of an Azipod propulsion system and a Kamewa control system. The course includes orientation to the transit mode (active rudders), independent manoeuvring mode, and the joystick mode. Simulation exercises are designed to provide a realistic transition from one mode to the next during all phases of manoeuvring that is from berth to berth.
STAR CENTER Dania Beach, Florida, USA	Azipod Familiarization	3	This course will introduce the student to the Podded Propulsion technology. The emphasis will be on honing the individual's shiphandling skills. There will be periods of classroom instruction / discussion with the balance of the sessions devoted to hands-on practice of typical piloting and docking manoeuvres using the 360° full mission bridge simulator in restricted waters, harbour manoeuvring, and docking / undocking simulations. Upon completing this course the student will be able to demonstrate gained knowledge of effective shiphandling using Azimuthing Propulsion Systems.
Maritime Simulation and Resource Centre, Québec, CANADA	Azimuthing Podded Propulsion	2	Enable navigators to become acquainted with this "new" mode of propulsion and acquire a good grasp of both the limitations and the advantages of this technology.
ABB Marine Academy FINLAND	General Course for Deck Staff	4	Upon completion of this course, the participants will: • Be able to communicate effectively with the involved engineering/electrical personnel. • Understand fundamental open sea operation. • Be able to use the Azipod ® as the manoeuvring device in near-

			alongside operation. • Effectively use backup functions in abnormal equipment states. • Perform user operations and settings with the Joystick/DP facility
CSMART Center for Simulator Maritime Training, owned by Carnival THE NETHERLANDS	Ship Handling course	4.5	The goals of this course are to: • Improve safety at sea by providing participants with knowledge and hands on skills training about methods for the safe operation of ships in narrow fairways, port approaches and during berthing and unberthing operations in varying weather and sea conditions. • Counteract complacency by exposing participants to unique and unusual situations relevant to the maritime environment. • Enable participants to understand the importance to safety by making a risk assessment and to develop a strategy for the operation.
STC B.V. Centre for Simulator Maritime Research & Training owned by STC Group, Rotterdam, The Netherlands	Ship Handling course (with or without Azimuthing drives)	3-5	Basic and advanced ship handling courses are given by STC. Depending on the wishes of the clients these courses can be given for ships with/without azimuthing drives.
STC B.V. Centre for Simulator Maritime Research & Training owned by STC Group, Rotterdam, The Netherlands	Tug Handling course (with or without Azimuthing drives)	3-5	Basic and advanced ship handling courses are given by STC. Depending on the wishes of the clients these courses can be given for ships with/without azimuthing drives.
FORCE Technology DENMARK	Tug Handling Course	Variable	During theoretical lessons and practical simulator exercises, the participants shall: • Enhance their knowledge of, and skills in – ASD tug manoeuvring. • Enhance their knowledge of Human Factor Issues and skills in the use of Human Factor Issues, such as communication, planning, briefing and situational awareness. • Enhance safety by applying the proper procedures for conducting safe tug operations.
South Tyneside College UK	Tug Handling Course	Variable	The content will vary after a needs analysis has been completed of the attendees but would vary from basic handling of ASD or Voith tugs when free running , to ship operations – vessel stopped up to operations on bow and

			stern of a moving vessel. Failure of ship and/or tug can be looked at as desired.
MARIN THE NETHERLANDS	Lamnalco Tug Master Training	Variable	The objective of the basic ASD training was to train new ASD Tug masters in: • General ASD tug handling principles (free sailing, sidestep, keeping position, etc.); • General principles of pushing, towing and escorting in direct and indirect modes (including transverse arrest, indirect steering and breaking); • Specific manoeuvres with marginal manoeuvring space during berthing and unberthing.

Some of the training facilities mentioned above provide more details:

- **3-day Azipod Familiarization Training at STAR CENTER**

Scope
The demands of modern day ship operations in the ports of the world require that mariners and pilots be taught more than the traditional standard basic skills of their craft. While some responsible owners are providing intensive training for their officers and crews in the use of new technology and equipment, few pilots will have had the benefit of any prior knowledge until the vessel arrives at their bar. Since pilots bring local knowledge and shiphandling skills aboard and are mandated by their licensing authorities to ensure the safe navigation of the vessels they serve, it is essential they become familiar with the bridge equipment they will use during the vessel’s transit.
Despite a lack of standardization in bridge equipment such as found in the airline industry, pilots are justifiably proud of their ability to adapt to different ships, different equipment, and different cultures. However, the growing use of sophisticated electronic- and computer-controlled systems will require that pilots supplement their basic abilities and shiphandling experience with specific training in the use of this technology. This is already a widely accepted practice with regard to radar and ARPA certification.
Furthermore, new and larger ships calling at ports and waterways present unique challenges as pilots attempt to assimilate them into the existing infrastructure. In some cases, new ports and terminals present their own problems as pilots struggle to cope with the unfamiliar.
This course will introduce the student to the Podded Propulsion technology. The emphasis will be on honing the individual’s shiphandling skills. There will be periods of classroom instruction / discussion with the balance of the sessions devoted to hands-on practice of typical piloting and docking manoeuvres using the 360° full mission bridge simulator in restricted waters, harbour manoeuvring, and docking / undocking simulations.

Objectives
Upon completing this course the student will be able to demonstrate gained knowledge of effective shiphandling using Azimuthing Propulsion Systems.

Entry Standards

- At least 18 years of age
- Speak & understands English
- Company & personal requirements for utilizing Azimuthing Propulsion Systems for handling vessels equipped with same.

- **2-day training with Azimuthing Podded Propulsion at Marine Simulation and Resource Centre, Québec**

Objectives:
Enable pilots to become acquainted with this “new” mode of propulsion and acquire a good grasp of both the limitations and the advantages of this technology.

Duration & Schedule:
12 hours (2 days)
A.M.: 8:30 to 11:30
P.M.: 12:30 to 3:30
This schedule may be altered depending on the group and/or certain constraints.

Participants:
Preferably two (2).

Teaching strategies used:
Basically a hands-on approach.
Brief theoretical explanations and exercises on the Full Mission Bridge Simulator.

Training activities:
Theory followed by simulation exercises.
Discussions among participants recommended during manoeuvres.

Notes about the exercises:
Undocking without outside factors, undocking with a current, undocking with a current and wind, docking without outside factors, docking with a current, docking with a current and wind, undocking and docking with limited room to manoeuvre. The exercises become increasingly difficult and are followed by a short self-evaluation period (with assistance from the trainer, as needed).

- **Operation of diesel electric Azipod® vessels in a safe and economical manner by ABB MARINE ACADEMY**

Description
Operation of a twin Azipod® vessel with emphasis on pilot voyage and harbour manoeuvres. Training consists of practical lessons on diesel electric Azipod® propulsion and bridge simulator exercises.
The course has been developed in cooperation with Aboa Mare Maritime Institute.

Student Profile
- Onboard and onshore operational and technical personnel.
- Pilots and personnel of maritime authorities and classification societies.

Prerequisites
The target learners should have a sufficient knowledge of operation of modern vessels and to have experience on bridge simulator training.

Course Objectives
After completing this training, the participants will be
- familiar with the operational principles of diesel-electric (DE) Azipod® propulsion systems taking into account:
  - Passenger safety and comfort
  - Environmental requirements
  - Economical requirements

- able to utilize the flexibility of the propulsion system
- able to identify potential malfunctions of the propulsion system and to cope with them without sacrificing passenger safety
- able to communicate about the different aspects of the propulsion system in a clear and concise manner

Main Topics

1. DE Azipod® vessel system functionalities:
   - Power plant, distribution and propulsion drives
   - Azipod® thrusters
   - Propulsion control
2. DE Azipod® vessel operation with emphasis on pilot voyage and harbour manoeuvres:
   - Azipod® operations
     - Speed control
     - Transverse thrust
     - Station keeping
     - Control of pivot point
     - Crabbing / Side stepping
     - External forces
   - Special conditions
3. Power plant behaviour in different load conditions:
   - Optimizing power plant loading
   - Reverse power
   - Increase/Decrease -function
4. Effects of power plant and propulsion system malfunctions

➢ **Ship Handling course offered by CSMART**

Course summary:

The course shall provide the following format to benefit participants:

- Conduct training during the critical stage of transferring controls from the centre console to the bridge wings.
- Provide full bridge team participation using procedures for error management combined with safe and efficient communication.
- Utilize mentoring techniques for Captains to effectively develop ship handling skills combined with a healthy level of self confidence in more junior members of the bridge team.
- Offer a tailor made course for every customer and ship type with various propulsion and rudder configurations.

Goals & Objectives:

The goals of this course are the following:

- Improve safety at sea by providing participants with knowledge and hands on skills training about methods for the safe operation of ships in narrow fairways, port approaches and during berthing and unberthing operations in varying weather and sea conditions.
- Counteract complacency by exposing participants to unique and unusual situations relevant to the maritime environment.
- Enable participants to understand the importance to safety by making a risk assessment and to develop a strategy for the operation.
- A participant successfully completing this course will be able to:
- Understand the effects of the ship's behaviour when exposed to wind, current, shallow water, interaction and bank effect.
- Demonstrate competence in developing an operational strategy to be included in a detailed plan for the berthing/unberthing operation.

- Demonstrate competence in how to execute and monitor a planned operation making best use of all available resources.

Additional Course Details:
CSMART offers two full mission bridge simulators, six part-task bridge simulators and the ability to simulate fixed propeller and Azipod simulation.
The course is recognized by the MCA (Maritime and Coastguard Agency) and meets the principles laid down in Section A-11/2 and B-V/a of STCW-95 (Standards of Training, Certification, and Watchkeeping) as amended, regarding the training of Masters and Chief Officers of large ships.
The course is designed for Masters and Senior officers.
The maximum number of participants is 8.
The course is a 4.5 day course comprising 36 hours of training.

- **Ship Handling course offered by STC**

The STC Group has many different simulators. STC has, at their simulator centre facilities at the Wilhelminakade in Rotterdam, four full mission bridge simulators (Class A), a number of part-task bridge simulators and two dynamic positioning (dp) simulators. These simulators are able to model both conventional and unconventional propulsion units and thereby also Azipod units of all makes. The STC Group also has crane simulators, dredging simulators, fishing simulators, etc.).

The simulator centre is DNV certified, complies with STCW (Standards of Training, Certification, and Watchkeeping) for the training of Masters and Chief Officers and is further recognized by MCA (Maritime and Coastguard Agency).
The course is designed for Masters, Pilots and Senior officers.
The maximum number of participants is 32.
The courses can vary from 3-5 days comprising of 24-36 hours of training.
STC has a basic course and an advanced course for ship handling.

Course summary:
The course for ship handling given by experienced nautical officers/pilots focuses on the following subject matter:

- The basic theory of ship handling
- The formation of a bridge team, all members participating well via correct procedures and working together towards the single goal of proper ship handling
- The minimisation of possible errors
- The transferring of ship controls from the centre console to the bridge wings to the aft console (if present) and vice versa.
- Efficient communication bridge team internally and externally (tug boats, harbour authorities etc.)

Although a standard course is given, often these courses are tailor made (i.e. ship type and/or harbour configuration etc.) and can also be given at advanced level.

Goals & Objectives:
The goals of these courses are the following:

- Teach the participant the art of ship handling in a number of normal and abnormal conditions. By way of the theory lesson and hand-on training during the course, the knowledge of each course participant regarding safe ship operation under diverse manoeuvring conditions reaches a sufficient level whereby the required ship handling skills are met.
- Teach the participants to make a risk analysis as well as a planning to avoid any of these risks from occurring etc.

- Teach the participants how to handle in cases of failures on board by giving a number of contingency cases (e.g. Rudder failure, etc.) during the course
- Improve safety at sea and in the harbours etc. by being able to carry out proper ship handling under different conditions.

Tug handling course by STC
STC also has a basic course and an advanced course for tug handling for all types of tugs including Azimuth Stern Drive. These courses are for tug captains and officers. Custom made courses for these tugs are also available upon request.
The course is a mix of relevant theory followed by dedicated training sessions through practice on the simulator.
A number of different tug boats are available and a custom made tug boat can also be modelled if requested. A number of full-mission bridge simulators are available for these courses and may be used interactively if requested.

The objectives of the courses:
Based on theory lessons and practical exercises on the simulator, course participants gain:

- An increase in knowledge and insight into tug handling procedures and thus reach a higher overall safety level regarding tug operations
- An increase of their knowledge (and also thereby skills) of ASD tug manoeuvring
- An increase of their knowledge regarding situational awareness, planning, briefing, communication and working as a team.

- **ASD Tug handling course by FORCE TECHNOLOGY**

Force Technology – DMI has developed a 3 level training program for Azimuth Stern Drive Tug Captains and Officers.
During the course relevant theory is taught and then tested in “real life” on the simulator.
A full-mission ASD “tug and tow” simulator has been developed based on towing tank tests and calibrated by experienced ASD captains. The full mission tug simulator is coupled to tug cubicles and full mission simulators as described in Appendix B Tug Handling brochure.

The objectives of the courses:
During theoretical lessons and practical simulator exercises, the participants shall:

- Enhance their knowledge of, and skills in – ASD tug manoeuvring
- Enhance their knowledge of Human Factor Issues and skills in the use of Human Factor Issues, such as communication, planning, briefing and situational awareness.
- Enhance safety by applying the proper procedures for conducting safe tug operations

Level 1: Safe handling of own tug during navigation, manoeuvring and basic towage operation

Level 2: Safe handling of own tug and towed vessel during normal towage operation

Level 3: Safe handling of towage operations in extraordinary conditions

All levels of Tug handling Courses will include the following issues:

- Familiarization with the simulator
- Procedures for Start-up and stop
- Familiarization with the manoeuvring handles and equipment
- Back-up procedures
- Ship/Tug handling theory on different levels

Tug Handling Course Level 1:
Addresses the following issues:

- Navigating with the ASD tug, ahead – astern – turning – 2 / 1 azimuth
- Manoeuvring with the ASD tug, Sidestep, manoeuvring ahead / astern

- Before / after towing procedures
- Approaching and connecting to different positions on a vessel, pulling / pushing
- Safety, accidents and errors – how to manage errors – procedures

Tug Handling Course Level 2:

Addresses the following issues:

- Safety, accidents and errors – Resource management
- Before / after towing procedures
- Approaching and connecting to different positions on a vessel, pulling / pushing
- Towing of "cold" vessel – in and out of dry-dock
- Escort Towing
- Experience the operation from the Pilot and Captains point of view, do the manoeuvring from the bridge of the assisted vessel
- If marine pilot(s) participate (recommendable) they will experience the operation seen from the tug and interact during sessions and debriefings to improve the teamwork/spirit.

The course is very flexible as the contents can be adjusted to the wishes, qualifications and experience of the participants. Special emphasis on e.g. escort towage can be included and the exercises may be conducted in areas selected by the participants, if available.

Tug Handling Course Level 3:

Addresses the following issues:

- Emergency procedures
- Human Factor theory related to towing
- Assisting vessels in complicated operations in different types of ports
- Assisting during STS operations
- Trying out the operational limits with regards to speed, environment etc
- Tow master training
- Complicated towing operations of odd floating objects.

4. TRAINING AVAILABLE ON DESKTOP SIMULATORS

Two-dimensional desktop simulation is used mainly by port engineers for their port layout studies.
We know about some desktop simulators installed onboard ships aiming at training the crew during their trips, but we have had no return of experience on this kind of training.
Desktop simulation does not give a reasonably "true" feeling to the user, so it is not a practical tool for training at this moment.

5. TRAINING AVAILABLE ON MANNED MODELS

Manned models are used for training and for research and are accepted as an excellent method for simulation of ship behaviour.
Both Port Revel (PRL near Grenoble, France) and Shiphandling Research Training Centre (SRTC at Ilawa, Poland) own manned models with podded propulsion at scale 1:25 and 1:24.
As far as we know they are the only ones in the world at this time (mid 2010).

- **Port Revel (France)**

At Port Revel (see Appendix 1) it was decided to show students the best solutions for using pods, rather than giving them procedures to follow. Students get to grips with the model by being placed in increasingly difficult conditions as the course progresses.

This 5-day course is operational since 2006 and had trained nearly 100 pilots and masters at the end of 2009.

On day one, some general information on podded ships is presented and then a few explanations regarding the use of the pods on the model and the day's exercises are given.
For their first contact with the podded ship, students must leave a quay, follow a circuit with different modes (pods synchronised or independent, fast or normal mode) and then berth in the "T-bone" mode (one pod aligned and one pod at 90°).
The students are monitored and observed constantly in order to adapt their manoeuvre if necessary and, especially, be able to discuss it during the evening debriefing.

On day two, students are introduced to the various ways to stop a podded ship. Then they are shown various modes for precision steering at low speeds in restricted waters using pods with inboard or outboard rotation. The torque generated by the pods is explained, emphasising their efficiency, which depends on interactions between pods and with the quay structure, the various positions of the control units and their ergonomics.
The exercises give students an opportunity to test the various types of crash stops and the different pod positions for following a straight course or entering a lock forwards and backwards. Berthing manoeuvres are chosen depending on the wind conditions on the lake; they also highlight the torque generated by various pod positions.

On day three, the students carry out the exercises in various currents as this forces them to use more power and helps them develop reflexes in the proper use of pods.

On day four, exercises are performed with a beam current in front of a harbour basin. Some of the previous exercises may be repeated depending on the students' difficulties and specific requests regarding local conditions and configurations.

Day five is dedicated to exercises involving engine failures forcing students to manoeuvre with a single pod and help from a tug and/or anchors. If necessary, we go back over some of the previous exercises to clarify certain points which are considered difficult.

At the end of the course, 80% of the students steer accurately in narrow passages with current abeam, then turn at slow speed in the current and dock without losing time. Most students carry out this kind of exercise quite intuitively, which is considered a good result of the course.

- **Shiphandling Research Training Centre (Poland)**

At Ilawa's Ship Handling Research and Training Centre (see Appendix 2) the course is designed for Masters and Chief Officers from ships equipped with Azipod propulsion and for pilots from harbours operating such ships. The course objective is to understand better the complex physical phenomena affecting manoeuvrability of ships equipped with Azipods and to gain more detailed practical knowledge on handling of these ships.

The course duration is 3 days.

The scope of lectures and practical exercises programme is flexible. All training areas as the rule do not repeat actual situations in various geographical areas, but are combinations of different difficult situations which could be met by the trainee. There is however a possibility to adjust the programme of exercises and to arrange any special situation by constructing special mock-ups of floating structures, locks etc. or mark particular harbour entrances according to individual requirements.

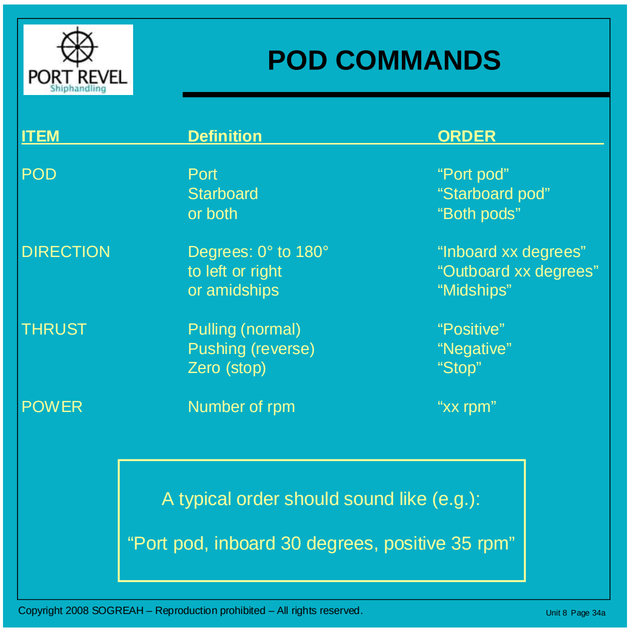
On day one, a lecture is given on the principles of manned models, manoeuvring qualities and principles of handling of ships equipped with Azipods. The practical exercises include turning with use of one or two pods, backward motion, crabbing, stopping, navigation onto leading marks, narrow passages, sharp turns and bow thruster work (on request).

On day two, the lecture covers cooperation with tugs and the effect of wind. The practical exercises include harbour manoeuvres, canal navigation and the effect of wind on ship's manoeuvrability.

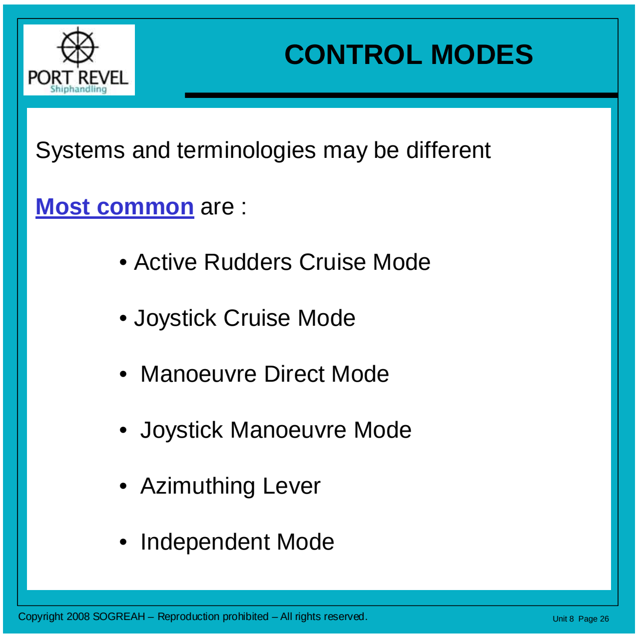
On day three, the lecture concerns the effect of current and the practical exercises include navigation in current in deep and shallow water conditions.

6. TERMINOLOGY

Pod Commands that are used at the Port Revel Training Centre are deduced from the Baken and Burkley "Azipod Maneuvering Terminology" (March 2008). See Appendix 3:



Further definitions concern the pod control modes. See Appendix 4:



7. REFERENCES

Jeff BAKEN, G. BURKLEY, “Azipod Maneuvering Terminology”, Publ. MPI, Covington, LA, March 2008.

APPENDIX 1 – Port Revel's "Pod Training"

Port Revel introduces PODS into its training courses

A. de Graauw, Director, Port Revel Shiphandling

To make the shiphandling training centre even more attractive for ships' pilots and captains, it was decided in 2006 to introduce pod propulsion on one of its 1:25 scale models (see www.portrevel.com).

Pods considerably affect the way a ship handles. At cruising speed, the diameter of the turning circle is greatly reduced, even though pods do not rotate more than 35°, like a conventional rudder. In manoeuvring situations, the 360° rotation of the pods means that thrust can be created in any direction, let alone combinations in which one pod is operating ahead and astern and the other at an angle of 90° ("T-Bone"), and combinations with bow thrusters, which enable the ship to move parallel to itself ("crabbing").

It thus seems that there is considerable room for experimentation with this type of propulsion.

At Port Revel, pod propulsion is optional, that is to say that the ship may be fitted with pods to reproduce the behaviour of a 275 m cruise liner, or else fitted with conventional propulsion including a rudder and propeller to reproduce the behaviour of 4400 TEU container ships (the Normandie, formerly CMA-CGM). It is also possible to reproduce a ship with two propellers and a central rudder.

The pod parameters were borrowed from the Queen Mary 2, including the "fast" and "standard" modes with their accelerations and decelerations and the possible associated limitations in terms of torque and azimuth.

A specific training course was therefore set up for experienced pilots and captains who wish to discover the possibilities of pods in shiphandling. This course is obviously carried out without using a joystick but with the conventional Stork-Kwant controls identical to those on the QM2.

The course covers such operations as:

- Docking and undocking with a current.
- Crabbing, with pods and bow thruster.
- Backing into a slip.
- Manoeuvring with a single pod (in the event of failure).
- Emergency stopping.

A course of this kind can also usefully involve the following:

- emergency operations with escort tugs,
- operations in the local conditions to which students are accustomed.

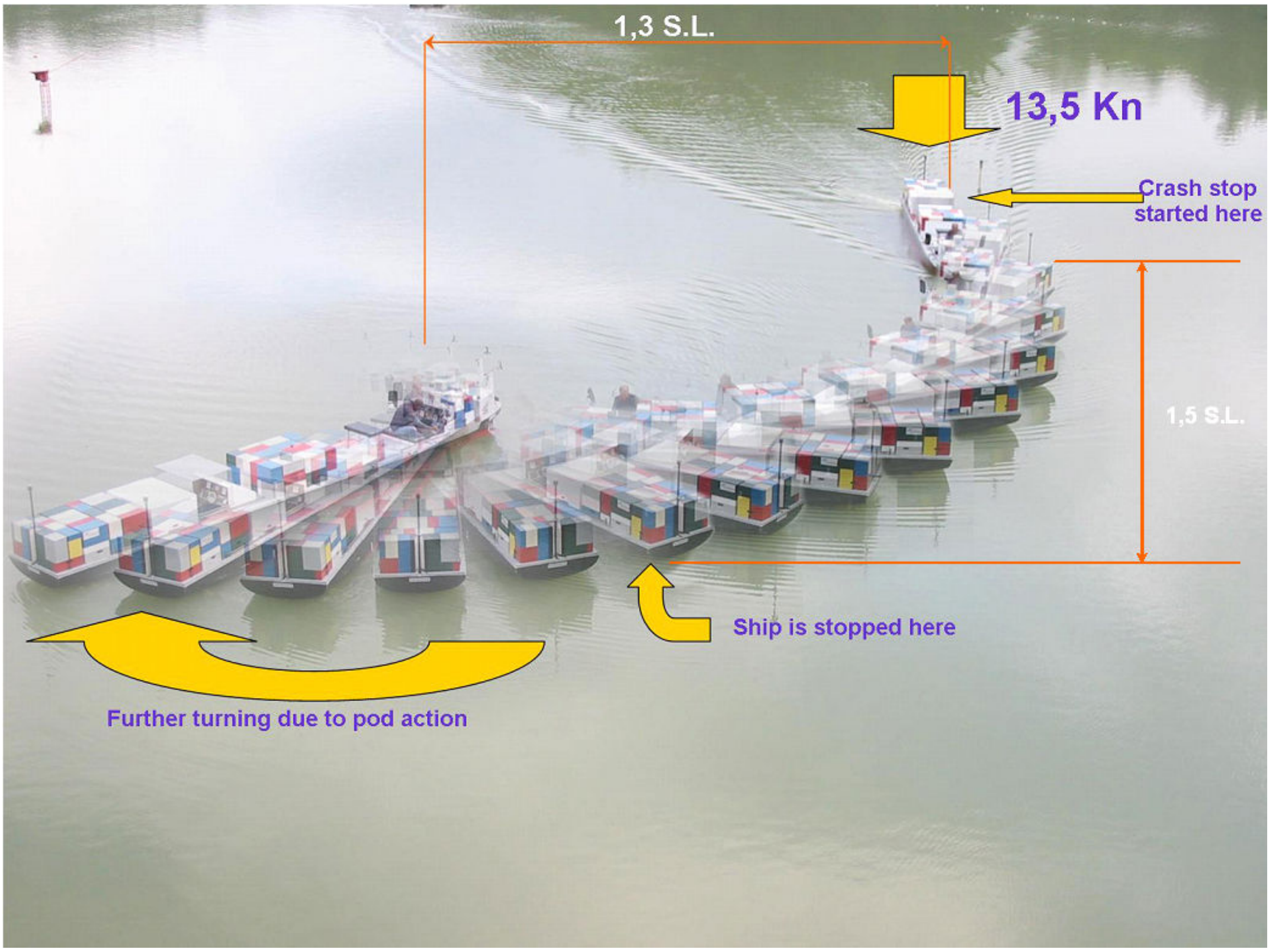
The first two courses of this kind were carried out during the summer of 2006 with pilots from San Francisco, who returned home delighted with their experience at Port Revel. Most of them were at Port Revel for the fourth time in their career to perfect their skills.

As far as the 7 instructors at Port Revel are concerned, they were also extremely eager to discover the possibilities offered by pods, in particular for emergency manoeuvres. For example, they were able to crash stop a ship heading at 13.5 knots in one and a half times its length. A feat of this kind would probably cause a little breakage on board, but if it is going to save human life….

The container carrier Normandie converted into a 275 m cruise liner with the bridge to the bow.

One of the two 21.5 MW pods installed
on the Normandie

Stork-Kwant control unit
for operating pods



Crash stop by turning the ship. With an initial speed of 13.5 knots, the ship is stopped in 120 seconds, in an area equivalent to only 1.5 x 1.3 times its length.

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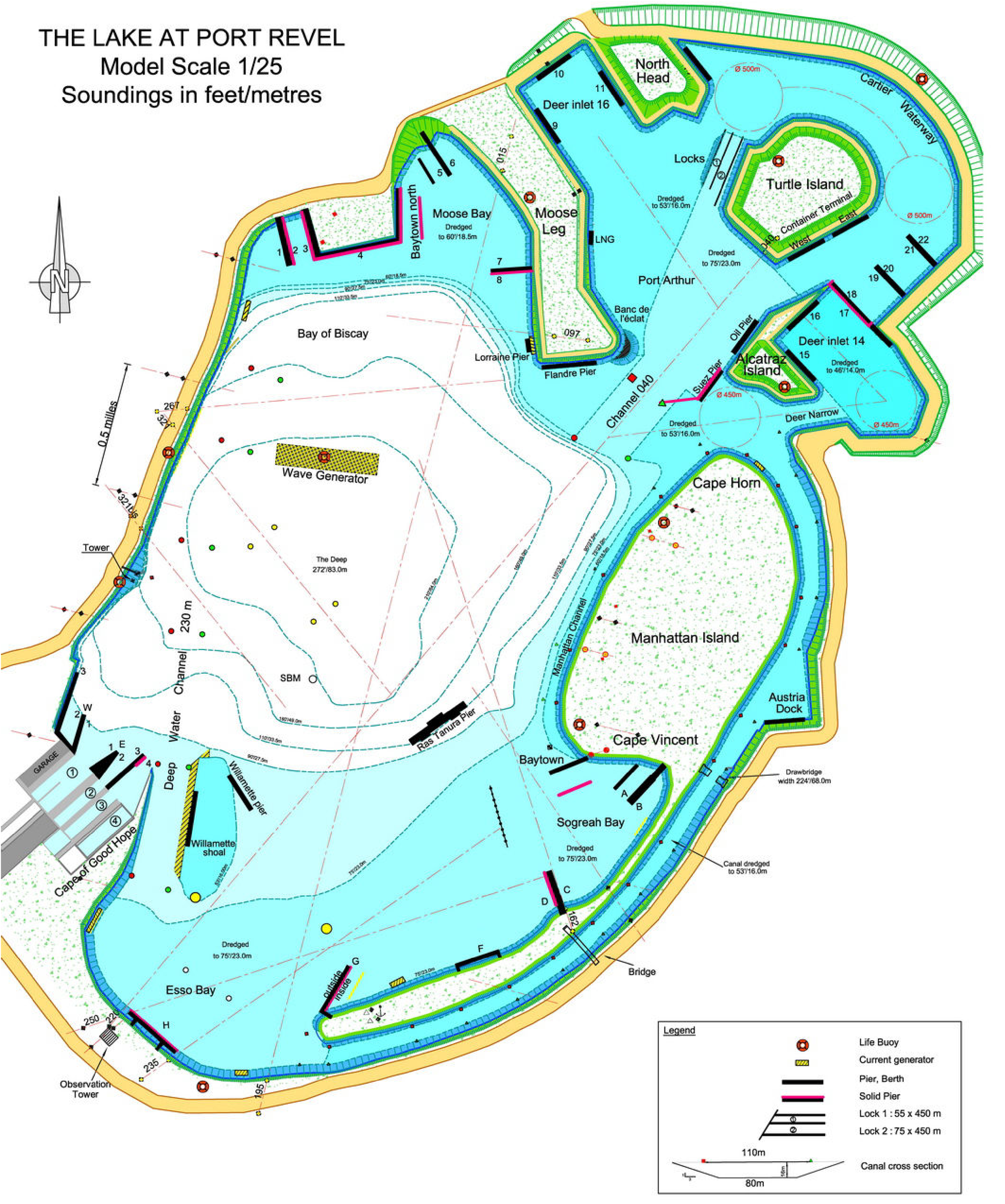
THE LAKE AT PORT REVEL
Model Scale 1/25
Soundings in feet/metres



SCALE CHART/LAKE

0.0 25 50m

SCALES :

0 1/2 1 nautical mile

ECHELLE : 1 / 1000 ème - (FORMAT A3)

PORT REVEL Shiphandling

SOGREAH CONSULTANTS

APPENDIX 2 – Ilawa's "Handling ships equipped with azipods"

Season 2008: lng/azipods

COURSE FILE

1. Course title:

“Handling ships equipped with azipods”

2. Course objective:

The course is designed for Masters and Chief Officers from ships equipped with azipod propulsion and for Pilots from harbours operating such a ships. The course objective is to understand better the complex physical phenomena affecting manoeuvrability of ships equipped with azipods and to gain more detailed practical knowledge on handling of these ships.

3. Course duration and number participants:

- 3 days from Friday morning 8.00 till Sunday 17.00;
- 2 trainees can participate in training at the same time;

4. Course programme:

The scope of lectures and practical exercises programme is flexible. All training areas as the rule do not repeat actual situations in various geographical areas, but are combinations of different difficult situations which could be met by the trainee. There is, however, a possibility to adjust the programme of exercises and to arrange any special situation by constructing special mock-ups of floating structures, locks etc. or mark particular harbour entrances according to individual requirements.

Day 1 (Friday)

08:00 – 09:45 Lecture

- principles of manned model training: similitude laws, scale effect;
- manoeuvring qualities of ships equipped with azipods;
- principles of handling of ships equipped with azipods;

10:00 – 18:00 Practical exercises **(13:00 – 14:00** Lunch break);

- turning with use of one or two pods: slow and full ahead turns, accelerated turn, Williamson turn;
- backward motion;
- crabbing;
- stopping manoeuvre: by changing the direction of propeller rotation, by turning the podded propulsor around (180°), by ind irect manoeuvre.
- navigation onto leading marks;

- narrow passages;
- negotiating sharp turns;
- bow thruster work (on request);

18:00 – 18:30 Debriefing,

Day 2 (Saturday)

08:00 – 09:00 Lecture

- cooperation with tugs;
- the effect of wind;

09:15 – 18:00 Practical exercises, **(13:00 – 14:00** Lunch break),

- harbour manoeuvres: swinging a ship in turning areas, berthing and unberthing manoeuvres in terminals with different pier configuration and different pier construction
- canal navigation, slowing down and stopping in the canal;
- effect of wind on ship's manoeuvrability: ship in ahead or astern motion, different direction of wind;

18:00 – 18:30 Debriefing,

Day 3 (Sunday)

08:00 – 09:00 Lecture

- the effect of current;

09:15 – 16:30 Practical exercises, **(13:00 – 14:00** Lunch break);

- navigation in current – deep water conditions (against current and with current, turning in current, berthing in current, entering a sheltered harbour)
- navigation in current – shallow water conditions (against current and with current, turning in current, berthing in current);

16:30 – 17:00 Closing the course.

5. Available ship models:

The training model " DORCHESTER LADY" is representing a large LNG carrier (140 000 m^3) fitted with azipod propulsion and scaled down 1:24. The model is equipped with:

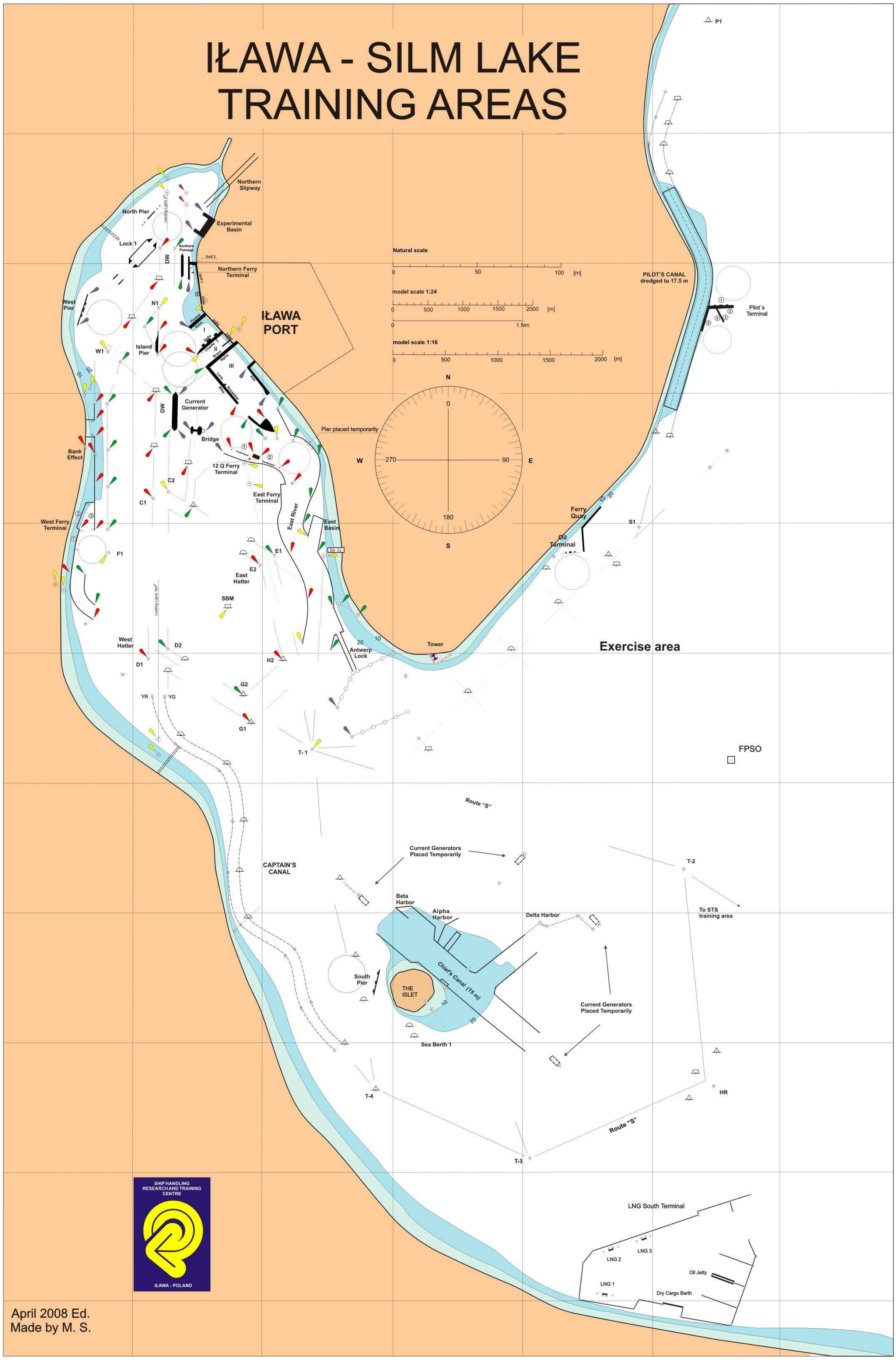
- two azipods working simultaneously or separately,
- simulator of a tractor tug working at the bow (60 tons of bollard pull),
- GPS with simulator of ECDIS;
- on request bow thruster;

- on request an additional tug assisting at the stern (up to 80 tons of bollard pull) - manned model of a Z-drive tug;

Photos presented below show the training model and the control desk of installed azipod propulsion:

photo no 1: the azipod propulsion installed onboard the training model of a LNG carrier

photo no 2: control desk of the pod system of propulsion


IŁAWA - SILM LAKE
TRAINING AREAS
Northern Slipway
North Pier
Experimental Basin
Lock 1
Northern Ferry Terminal
IŁAWA PORT
West Pier
N1
Island Pier
W1
Current Generator
Bridge
12 Q Ferry Terminal
Pier placed temporarily
Bank Effect
C2
C1
East Ferry Terminal
East River
East Basin
West Ferry Terminal
F1
E1
E2
East Hatter
SBM
West Hatter
D2
D1
H2
Antwerp Lock
Tower
Exercise area
G2
YR
YG
G1
T- 1
FPSO
Natural scale
model scale 1:24
model scale 1:16
N
W
E
S
Ferry Quay
Oil Terminal
S1
PILOT'S CANAL dredged to 17.5 m
Pilot's Terminal
P1
Route "S"
Current Generators Placed Temporarily
CAPTAIN'S CANAL
T-2
To STS training area
Beta Harbor
Alpha Harbor
Delta Harbor
South Pier
THE ISLET
Chief's Canal (15 m)
Sea Berth 1
Current Generators Placed Temporarily
T-4
HR
Route "S"
T-3
LNG South Terminal
LNG 2
LNG 3
Oil Jetty
LNG 1
Dry Cargo Berth
SHIP HANDLING RESEARCH AND TRAINING CENTRE
IŁAWA - POLAND
April 2008 Ed.
Made by M. S.

APPENDIX 3 – Baken & Burkley's "Azipod Maneuvering Terminology"

Azipod Maneuvering Terminology

Presented to the APA West Coast Pilots Conference

March 2008

Co-Authored by:

Capt. Jeff Baken **Pyxis Nautica LLC** **Southeast Alaska Pilots' Association**	**Mr. George Burkley** **LOCUS LLC** **Maritime Pilots Institute**

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Introduction

The rapid deployment of azipod technology has outpaced the traditional control terminology used for maneuvering. The following Azipod Maneuvering Terminology is offered so that Pilots may successfully communicate with bridge teams and control the direct maneuvering of podded-ship systems. This control language was developed and tested in the simulator and has been vetted on cruise ships over the past three years. (Note: This terminology was developed primarily from ABB/EMRI azipod/control systems. The controls and modes from other manufacturers will differ from those presented here; however, the concepts are the same and apply, regardless of the system manufacturer.)

Master/Pilot Exchange (MPX)

The use of azipods can be complicated, given the various maneuvering modes and almost infinite number of pod-attitude and pod-thrust combinations. Aboard pod-equipped vessels, communications between the Master and the Pilot, especially during the Master/Pilot Exchange, take on added importance due to propulsion system complexity. It is crucial that the Master and Pilot agree on the specific terms to be used and that there be absolute clarity of understanding for proposed maneuvers; as well as, which maneuvering mode(s) will be utilized during the voyage. It is important that the individual with the conn keep the bridge crew informed as to maneuvering intentions. A simple way to accomplish this will be to issue commands, followed by a simple statement of intent.

Manual Azipod Maneuvering (AZIMAN)

Command Syntax for Manual Azipod Maneuvering

The syntax for independent pod control:

1. Identification of the pod to be used
2. Ordering the direction of the pod rotation
3. Ordering the degree of pod rotation
4. Ordering the direction of power application
5. Ordering the amount of power
    a. Example: “Starboard Pod...Inboard…40 Degrees”
    b. Example: “Port Pod…Negative…40 RPM’s”

Note: Give split-propulsion commands one pod at a time

Command Terminology for Manual Azipod Maneuvering

Term	Command Definition	Spoken as…
Pods	Azipods	"Pods"
Direction of pod rotation	Inboard or Outboard	"Inboard" or "Outboard"
Degree of pod rotation	Degrees from 0° to 180° (inboard or outboard) *(note: may substitute "'midships" for 0° if marked as such on the console)*	"40 Degrees"
Direction of power application	Propellers Pulling (Ahead) or Pushing (Astern)	"Positive" or "Negative"
--Amount of power in RPM's	Amount of RPM's spoken as integer	"30 RPM's"
--Amount of power in pitch settings	Amount of pitch spoken as an integer or percentage	"Pitch-3" or "Pitch-30%"
--Amount of power in lever settings	Lever setting spoken as an integer	"Lever-3"

Example Commands for Manual Azipod Maneuvering

O-----------Command Sequence----------->>					
Pod ID	**Direction of Pod Rotation**	**Degree of Pod Rotation**	**Direction of Power**	**RPM, Pitch, Lever**	**Spoken Command**
Starboard Pod	Inboard	135°	None	None	"Starboard Pod…Inboard…135 Degrees"
Starboard Pod	Already in position	Already in position	Positive	30 RPM's	"Starboard Pod…Positive…30 RPM's"
Port Pod	Already in position	Already in position	Negative	40 RPM's	"Port Pod…Negative…40 RPM's"
Both Pods	Already in position	Already in position	Direction previously applied	Zero (RPM's, Pitch, or Lever)	"Both Pods…Stop"
Both Pods	Inboard (or Outboard)	0° ('Midships)	Direction previously applied	35 RPM's	"Both Pods…'Midships"

Azipod Joystick Maneuvering

Many azipod vessels are equipped with an integrated joystick (JS) system for propulsion and maneuvering control. This system integrates the pods and thrusters (except in JS cruise mode, where thrusters are controlled separately) to control the attitude of the vessel (heading) and allowing for selection of pivot points for translational maneuvers (vectoring sideways). It should be noted that in joystick maneuvering, the pods do not rotate aft of 75 degrees; therefore, negative RPM's are used to induce astern vectors. Some joystick systems include dynamic positioning (DP) capability allowing the vessel to hold position automatically, using the GPS and other sensors. The following command sequences and syntax are for pilots operating azipod vessels while using Joystick Modes. (Note: these JS and DP commands have not been subject to the degree of vetting as the commands for manual azipod maneuvering presented above.)

Command Syntax for Joystick Maneuvering

The syntax for azipod joystick maneuvering:

1. Identification of the control equipment to be used (e.g., joystick or mini-wheel)
2. Ordering the direction of rotation
3. Ordering the degree of rotation
4. Ordering the direction of the power
5. Ordering the amount of the power
    a. Example: "Joystick…Port…135 Degrees"
    b. Example: "Joystick…Positive…20 Percent"
    c. Example: "Mini-Wheel…Starboard…30 Percent"

Command Terminology for Joystick Modes and Maneuvering

Term	Command Definition	Spoken as…
Non-joystick Modes		
Open Sea Mode	Transit mode for synchronized pod control.	"Call Open Sea Mode"
Maneuver Mode	Mode for independent pod control.	"Call Maneuver Mode" (or "Call Aziman")
Joystick Modes and Terms		
Joystick Mode	Selection of the integrated joystick system (transferring control to the joystick control panel) from either Open Sea or Maneuvering Modes.	"Call Joystick"
Joystick Cruise Mode	Joystick transit mode with synchronized pod control (thrusters controlled separately).	"Call JS Cruise Mode"
Joystick Maneuver Mode	Joystick translational maneuvering mode about differing pivot points.	"Call JS Maneuver Mode"
Joystick Dynamic Positioning Mode	Joystick mode holding the ship's position in-place.	"DP Mode"
Joystick Manual Heading	Uses the JS Mini-Wheel to control heading manually. The Mini-Wheel is labeled in "turning force" by percent. When rotated, the JS system creates the turning force ordered.	"JS Manual Heading"
Joystick Auto Heading	Uses the JS Rocker-Tiller or other control to set a heading in the joystick autopilot.	"JS Auto Heading"
Joystick	Translational Power Lever	"Joystick"
Direction of Joystick rotation	Port or Starboard	"Port" or "Starboard"
Amount of Joystick rotation	0° to 180° , (0° can be expressed as "'midships")	"120 Degrees"
Direction of Joystick power	Propellers pulling (Ahead) or pushing (Astern)	"Positive" or "Negative"
Amount of Joystick power	Percentage spoken as an integer	"30 Percent"
Amount of Joystick lever settings	Lever setting spoken as an integer	"Lever-3"
Joystick Pivot Center	Pivot point position at the center of the vessel. (The center pivot point is the default for all joystick modes.)	"Set Pivot Point Center"
Joystick Pivot Forward	Pivot point position at the forward of the vessel.	"Set Pivot Point Forward"

Joystick Pivot Aft	Pivot point position at the aft of the vessel.	"Set Pivot Point Aft"
Neutral Joystick Command (zero rotation and power)	Putting the Joystick in neutral (no power, no rotation). Can be two commands for stop and midships or single command as noted in the next column.	"Joystick…Stop" "Joystick…'Midships" Or single command: "Joystick…Zero-Zero"
Direction and power of Joystick Manual-Heading control Mini-Wheel	Port or starboard command for Mini-Wheel used to order turning power for changing the heading. Followed by power command in percent from 0% to 100%	"JS Mini-Wheel…Port…30 Percent"
Heading command for Auto-Heading using the Rocker-Tiller	The joystick autopilot system provides course-to-steer commands (each 'toggle' of the tiller changes heading by 0.5°).	"Course to Steer…120 Degrees"

Example Commands for Joystick Maneuvering

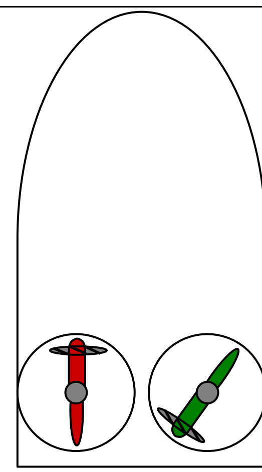
O--------------------Command Sequence------------------>>			
Control	**Direction**	**Amount**	**Spoken Command**
Joystick (rotation)	Starboard	135°	"Joystick…Starboard…135 Degrees"
Joystick (power)	Positive	30%	"Joystick…Positive…30 Percent"
Joystick Mini-Wheel (for swinging the ship)	Port	20% turning power	"JS Mini-Wheel…Port…20 Percent"
Joystick Rocker-Tiller (for setting a course to steer in auto heading)	Course to Steer	350°	"Course to Steer…350 Degrees"

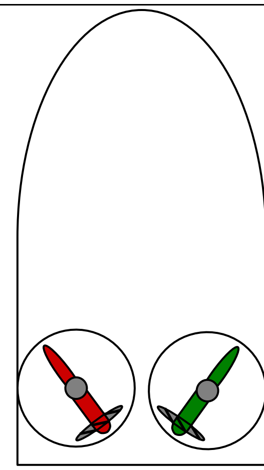
Appendix: Examples of Azipod Maneuvering

Example Pod Commands for Manual Maneuvering ("AZIMAN")

"Slow a Vessel and Turn Her to Starboard"

Setup:	The vessel is on a steady heading, making way at five knots, with the Pilot in command. The control system is in Maneuvering Mode, whereby the pod command levers are directly controlling the pods.
Scenario:	Slow and turn a vessel to starboard
Objective:	The pilot wishes to slow the vessel and commence a turn to starboard to steady on a new heading.
Overview:	To accomplish this maneuver, the pilot will stop the propellers, keep the port pod 'midships and swing the starboard pod inboard with 30 RPM.

Event	Command	Note
Prepare for turn	"Both Pods…Stop"	
Position pods for maneuvering	"Port Pod…'Midships" "Starboard Pod…Inboard…150°"	
Apply power to starboard pod	"Starboard Pod…Positive…30 RPM's"	This action begins to take some way off while commencing a turn to starboard.

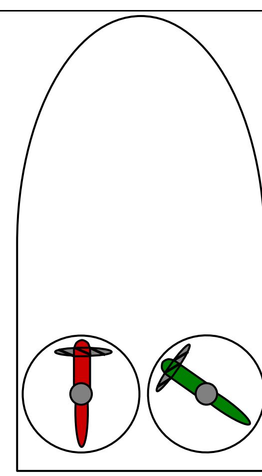
Position port pod	"Port Pod…Inboard…150°"	
Apply power to port pod	"Port Pod…Positive…30 RPM's"	This action enhances the slowing effect already being exerted by the starboard pod; while the vessel begins to steady up.
Steady on new heading	"Both Pods…'Midships" "Both Pods…Stop"	

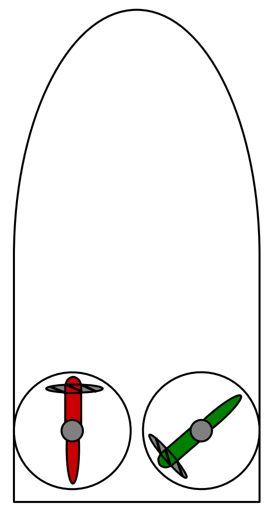
"Demonstration of All Azipod Maneuvering Modes to Berth a Cruise Vessel in Juneau"

Setup:	A cruise ship is approaching Juneau, Alaska, under pilotage in Open Sea Mode. The Pilot will take the vessel to the dock, transitioning through all available azipod maneuvering modes and completing required maneuvers to safely moor the vessel
Scenario:	Inbound at 5 knots, Open Sea Mode, Pilot at the conn
Objective:	Use all available azipod maneuvering modes to safely moor a cruise vessel to the berth in Juneau from the southern approach waters. The approach maneuver will entail turning hard to starboard, and maneuvering to a port-side docking at the Cruise Terminal (heading = 138°). The vessel is initially on a heading of 325°, making way at five knots
Overview:	Pilot will begin in Open Sea Mode and transition through maneuvering modes

Event	Command	Note
Transition from Open Sea Mode to JS Cruise Mode	"Call Joystick (JS)"	For a seamless transfer, try to align the JS power setting to match that which was in use in Open Sea Mode (in this case, about 30% on the JS), prior to transferring control. This action transfers control to the Joystick Control Panel (JCP) and into Joystick Cruise Mode (default) with Manual Heading (default).
Establish the JS Cruise Mode heading	"Auto Heading" "Course to Steer…325°"	The JS Cruise Mode, in Auto Heading, is used with heading commands. (In Manual Heading, the JS Mini-wheel is used to maintain heading manually.)
Begin to slow the ship	"Joystick…Positive…10%".	This is a decrease in power to slow the ship.
Transition to JS Maneuver Mode	"Call JS Maneuver Mode".	This transitions the control mode from JS Cruise to JS Maneuver in preparation for translational maneuvers via integrated joystick control of the pods and thrusters.
Prepare to initiate starboard turn	"Forward Pivot Point"	This sets the pivot point forward so that the pods will be the primary turning force in the turn. This is the first part of a two-part compound starboard turn.
Begin starboard turn	"Manual Heading" "JS Mini-wheel…starboard, 50%"	This acts to initiate the turn to starboard.
Increase turning force to starboard	"Center Pivot Point"	The integrated system automatically brings the bow thrusters into action and increases the rate of turn.

Event	Command	Note
Slow the ship in the turn	“Joystick…Stop”	Power off to further slow the ship Even with the JS in ‘Stop’, the pods continue to work transversely, under control of the JS Mini-wheel, to complete the turn.
Begin checking the turn	“JS Mini-wheel…‘Midships”	This stops the application of turning force; however, the ship continues to swing on its own momentum.
Steady-up on new heading for the docking approach	“Auto Heading”. “Course to Steer…110°”.	Return to JS Auto-Heading Mode The pods are applying zero power for forward movement, but the JS Auto-Heading mode continues to use the pods and thrusters to control the heading as the ship decelerates.
Slow the ship	“Joystick…Port…180°” (Either direction could have been used; e.g., “Joystick…Starboard…180°”) “Joystick…Positive…30%”	The pods act to “back down” - slowing the ship using 1/3rd power and negative RPM’s. (Remember in JS modes, the pods do not rotate more than 75 degrees aft. They are operating in negative RPM’s to create the astern force slowing the ship. There is some belief that negative RPM’s may put undue stress on the pod thrust bearings.)
Adjust approach angle 10 degrees and vector ship bodily left toward the dock	“Course to Steer…120°” “Joystick…Port…135°”	Thirty percent power is still on; this command introduces an oblique movement to port, while continuing to slow the ship and changing the heading to 120°.
Adjust approach angle toward the dock	“Course to Steer…130°”. “Joystick…Stop”.	Dock heading is 138°; the ship is now drifting slowly and aligning close to the final heading.

Event	Command	Note
Use Dynamic Positioning (DP) to completely stop the ship and align the vessel precisely with the dock	"Call DP Mode".	In order to enter DP Mode, the ship speed must be under two knots. In DP, the integrated system will automatically stop the ship and maneuver back to the GPS reference point that was established when the command was given. The ship is now stopped, dead in the water, aligned close to the dock heading and lying 30 meters off the dock.
Use DP to maneuver to within 15 meters of the dock	"Course to Steer…138°" "Joystick…Port…90°". "Joystick…Positive…30%". "Execute"	138° is the heading of the dock. The "Execute" command is required in DP Mode and is accomplished by pushing a flashing yellow button on the console. This action will bodily move the ship to the port, approximately 15 meters, while aligning to the heading of the dock.
Center the joystick in preparation for manual pod maneuvering during final docking	"Joystick…Stop" "Joystick…Midships" (or "Joystick…Zero, Zero")	These last two actions do nothing but center the joystick, which was deactivated as soon as the "Execute" button was pushed.
Transition from DP Mode to Manual Maneuvering Mode	"Call Aziman"	This command deactivates the Joystick Control Panel, and the three joystick modes. Now the ship is controlled by manual manipulation of the pods and bow thrusters.
Thrust the ship's stern to port and slowly slide her up the dock (forward)	"Starboard Pod…Inboard…45°" "Starboard Pod…Positive…20 RPM's"	

Event	Command	Note
Create an oblique slide of the ship to port	"Bow Thruster…Port 30%"	The bow thrusters balance the port 'thrust' and the ship moves obliquely to port.
Stop all forward motion and continue oblique slide to port	"Starboard Pod… Inboard…120°"	This angle of rotation acts to continue the lateral movement to port while reducing headway, to zero. 
Alongside finish	"Starboard Pod…Stop" "Bow Thruster…Stop"	The ship is alongside the dock.
Finished with Pods	"Make 'er fast, fore and aft!".	Quickly, before anything goes wrong!

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APPENDIX 4 – Port Revel's "Control Modes"

CONTROL MODES

Systems and terminologies may be different

Most common are :

- Active Rudders Cruise Mode
- Joystick Cruise Mode
- Manoeuvre Direct Mode
- Joystick Manoeuvre Mode
- Azimuthing Lever
- Independent Mode

Cruise modes are used in open sea. All other modes are used for manoeuvring.

Active Rudders Cruise Mode

- Similar to the conventional system
- Full power, conventional wheel (auto pilot available)
- Pods rotate to a maximum synchronised angle of :
  + / - 35 °, rate of turn similar to conventional rudder
- Good steering down to 1.5 – 3 knots
- Bow thrusters manually controlled

Remember that indicators show the **actual** pod angle

Joystick Cruise Mode

- Pods synchronised for both :
  Azimuthal rotation and RPM
- Rotation limited to : + / - 35°
- Joystick controls RPM ahead or astern
  (available power automatically limited)
- Joystick controls auto-pilot course changes
  (a Mini-Wheel controls manual course changes)
- Bow thrusters are not manually controlled

PORT REVEL Shiphandling

Manoeuvre Direct Mode

- This is a transition mode between Active Rudders Mode (full power available) and Manoeuvring Modes (least power available)
- Can be used to slow down the ship gradually as it adjusts the ship speed and the engine speed (RPM)
- Conventional steering : + / - 35°
  controlled by either a main wheel or a mini-wheel knob
- RPM are controlled by a traditional throttle

Power is limited to an intermediate value between the cruise modes and the manoeuvre modes.

Joystick Manoeuvre Mode

- A "**point and shoot**" method: a computer translates and optimizes the operator's inputs
- Pod rotations (360°), engine power and bow thruster forces are automatically balanced to produce the motion required
- Neutral or "Mid-ships position" is automatically limited to outward pod angles of : 25, 35 or 45 degrees (depending on the vessel's design)
- Mini-wheel allows the heading to be controlled manually by introducing a turning moment
- An artificial "point of rotation" around which the ship will rotate can be chosen at: the bow, amidships or the stern

Azimuthing Lever (AZIMAN)

- **One pod** is selected as the rotating one,
  the **other one** is fixed in ahead/astern position
- The selection can be changed quickly by pushing a button on the control desk
- Bow thrusters are controlled manually by a separate handle
- Selection of the pods' positions depends on the conditions of the manoeuvring operation
- Pod efficiency is based on the "pod to pod" and the "pod/hull" interactions and whether they are pulling or pushing

This mode is mostly used for manoeuvring and (un)docking.

Independent Mode

- Manoeuvring mode allowing control of both:

  Azimuthal rotation and RPM

- Each pod is controlled by its

  azimuthing lever

  and capable of rotating over 360°

- Bow thruster is controlled manually by a separate handle

This is the NORMANDIE's normal pod mode