AMPI

PPU Code Of Good Practice

for the implementation and use of Portable Piloting Units

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Recommended reference documents

IMPA - GUIDELINES ON THE DESIGN AND USE OF PORTABLE PILOT UNITS, 2016 - http://www.impahq.org/admin/resources/guidelines.pdf

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1. Introduction

The purpose of this AMPI Code is to provide not only technical information but guidance on the selection, implementation, training and policy that any pilotage provider needs to consider when purchasing, implementing or simply reviewing their existing systems.

Since the first Code was published in 2012 there has been significant improvement in PPU technology and also in the general acceptance of PPU as an essential tool for pilotage. The use of PPU is now generally viewed as "good practice" which comes with a degree of legal implication. It is essential for pilotage providers to not only select appropriate equipment for their application, but to include it in their safety management systems, training programs and maintenance systems. There may need to be a shift in thinking away from visual pilotage supported by electronic aids to incorporated visual/electronic pilotage.

Recent legal precedent has raised the status of the passage plan to a level where the very seaworthiness of the vessel is at stake. Therefore, the Pilot's electronic passage plan must be comprehensive, loaded on the PPU and shared with the ship.

Technological improvements will no doubt continue at pace. PPUs will increasingly become networked devices, sharing, gathering and recording information both within the vessel and externally. The use, storage and dissemination of this data will also need to be considered.

This Code sets out to provide minimum standards of performance for both hardware and software. It also aims to distinguish between those devices that can and cannot be described as a PPU.

This Code gives detailed requirements for each Class, with a mix of mandatory, recommended and possible components denoted by the words "must", "should" and "may".

Specifications, weights and battery life recommendations are made on the basis of currently available equipment and these figures will inevitably improve over time. Battery life is most important where batteries are not user changeable, which is true for most antenna units at present.

The identification of PPU classes has been based on four categories

- Very high accuracy independent heading berthing systems - Class A
- High accuracy dependent heading general piloting systems - Class B
- Ship dependent navigation systems - Class C
- Specialised PPU systems* - Class S

*Specialised systems for tasks such as ship to ship (STS) cargo transfers or tandem mooring (FPSO,FSO, FLNG) are now available which utilise antenna on more than one vessel. These communicate with each other and resolve the relative motion of each vessel. Such systems are highly specialised and outside the scope of this Code, but can be referred to as Class S.

It should also be noted that some systems have the flexibility to move from one Class to another based on optional or additional hardware. For example, augmenting a pilot plug based system with an additional position antenna converts a Class C PPU to a Class B. Conversely, a Class A system with a backup pilot plug module can become a Class C unit.

Very High Accuracy Independent Heading Berthing Systems are available with independent heading to the nearest 0.01 degree and speed with an accuracy of 0.05 of a knot. Rate of turn can now be measured to fractions of a degree per minute. All this in turn can create an accurate ship predictor which most importantly allows a pilot to tell at a glance exactly what the ship is doing right now as well as where it will be in a few minutes time. These units are normally slightly larger in physical size and weight than dependant units, and are used for where the very high precision is assessed as being necessary.

High Accuracy Dependent Heading General Piloting Systems provide excellent positioning accuracy but rely on a heading input from the piloted vessel. This heading is refined by an internal rate gyro to provide heading accuracy within a fraction of a degree. However, they may lack the very high precision required for some berthing applications, for example berths with specific landing speeds.

Ship Dependent Navigation Systems are completely reliant on the AIS output of the ship for position and heading. They use an internal rate gyro to refine the ship's heading to fractions of a degree and are only suitable for navigation pilotage.

All classes of PPU require professional grade PPU software and charts to conform to the class specification.

Any system which relies totally on ship's AIS data and does not augment or provide *any* independent input, cannot be considered a portable piloting unit for the purposes of this Code, regardless of the software and charts installed.

2. PPU Classes

PPU Class A – Very High Accuracy Independent Heading Berthing Systems

These high accuracy PPU's can be used for channel, docking and berthing operations where defined maximum fender landing speeds are specified.

Hardware

Mandatory requirements

1. Independent Positioning
   a. Very high positioning accuracy, <1.2m uncorrected GNSS
   b. Multi constellation GNSS receiver capable of utilising at least two GNSS constellations, ideally more.
   c. Differential corrections providing 0.3m or better position accuracy using either terrestrial (RTK) or space based (SBAS, Atlas etc) corrections services. These should be received directly by the PPU antenna.
   d. Performance integrity monitoring and notifications of any reduction in accuracies of the correction service. Notification of the accuracy level in use should be clearly displayed and obvious to the user.

2. Independent Heading
   a. Very high accuracy in heading resolution (order of magnitude 0.01 degree). Current independent heading technologies are either long baseline or carrier wave phase shift methods.

Suggested requirements

1. Internal Rate Gyro
   a. A rate gyro or similar technology may be used to assist with RoT calculations and heading integrity monitoring.
2. Roll sensor
   a. Using either accelerometers or high precision vertical positioning measurements, to detect the vessel's roll. This allows the ship's movement to be accommodated by the predictor in swell conditions.
3. AIS Data
   a. If AIS data is used for acquiring target information it should be received independently of the AIS plug. Due to range issues in some ports it is acknowledged that the ship's AIS data feed (pilot plug) could be a solution.

4. Battery Life
    a. Minimum run time on batteries alone should not be less than 10 hours, however port specific requirements may necessitate longer run times or interchangeable batteries.
5. Weight
    a. Gross weight should not exceed 8kg (not including display)
6. Redundancy of GNSS corrections
    a. If the primary corrections method becomes inoperable, the unit should be able to provide a high position accuracy via a different corrections method. This could be received directly by the PPU antenna or via 4G/5G network (NTRIP) through the laptop/tablet. Regardless, the corrections method in use must be displayed and obvious to the user.

Software

Mandatory requirements

1. Software Design
    i. Designed for precision pilotage and berthing
    ii. Specific docking/berthing information display
    iii. Indicate ship's speed along longitudinal & athwartships axis (bow and stern).
    iv. Display a customisable ship predictor based on independent heading, CoG, RoT, SoG, drift and optionally a roll sensor
2. Alarms
    i. Display an unambiguous visual and audible warnings when position and/or heading accuracy falls below a set threshold or there is any other threat to the integrity of the displayed data
    ii. The software must have robust performance monitoring and error display, and be configurable by the user
3. Charts
    i. Must be capable of displaying official electronic charts (ENCs)
4. Routes
    i. The software must be capable of displaying full route information equivalent to that of an ECDIS, including waypoints, turn radius and cross track margins
5. Tides
    i. The software must be capable of making allowances for tide height. This can be manual, automatic (based on predictions) or in the best case, live data
    ii. It must be obvious whether the displayed depth contours include or exclude tide height (as in ECDIS).
    iii. The software should be capable of displaying safe navigable water based on ship's draught, UKC allowance and height of tide
    iv. The software should be capable of integrating with a live UKC feed
6. Playback feature
    i. The software must have the ability to playback past recordings

Suggested requirements

1. Meeting Points
   i. Have the ability to display meeting points on same route by ships on reciprocal courses, taking account of multiple legs (using AIS data).
2. Docking lines
   i. Have the ability to define and select docking lines showing the distance from the ship to the berth or any other designated feature
   ii. Have the ability to toggle between knots, m/sec or cm/sec for closing speeds
   iii. A docking speed alarm
3. Recording
   i. The software should automatically record on start up.
4. Voice and video
   i. The software may be capable of recording voice and optionally video.
5. Bathymetric Charts and Overlays
   i. Ability to display Bathymetric Electronic Charts (bENCs) and engineering drawing files (such as dwg, dfx)

PPU Class B - High Accuracy Dependant Heading General Piloting Systems

These high accuracy PPUs can used for channel and berthing operations, however the heading feed is dependent on the vessel's gyro compass. This is received either via the pilot plug (wired or wireless) or through the VHF AIS transmission. Whilst this class of unit may be used during berthing operations, this system may not be suitable for ensuring critical fender landing speeds are achieved due to the inerrant limitations of the hardware.

Hardware

Mandatory requirements

1. Independent Positioning
   a. High positioning accuracy, <2.5m uncorrected GNSS
   b. Multi constellation GNSS receiver capable of utilising <u>at least</u> two GNSS constellations, ideally more.
   c. Performance integrity monitoring and notifications of any reduction in accuracy of positioning signal. Notification of the accuracy level in use should be clearly displayed and obvious to the user.

2. Refined Heading
   a. An internal rate gyro, or similar technology, to refine the ship's gyro heading to fractions of a degree to assist with independent RoT calculations

Suggested requirements

1. Differential Corrections
   i. Differential corrections providing 0.7 m or better position accuracy using either terrestrial (RTK) or space based (SBAS, Atlas etc) corrections services received directly by the PPU antenna or via 4G/5G
   ii. Performance integrity monitoring and notifications of any reduction in accuracy of the correction service. Notification of the accuracy level in use should be clearly displayed and obvious to the user.
2. Redundancy of differential corrections
   b. If the primary corrections method becomes inoperable, the unit may be able to provide high position accuracy through a secondary corrections method. This could be received directly by the PPU antenna or via 4G/5G network (NTRIP) through the laptop/tablet. Regardless, the corrections method in use must be displayed and obvious to the user.
3. AIS Data
   i. If AIS data is used for acquiring target information it should be received independently of the AIS plug. Due to range issues in some ports it is acknowledged that the ship's AIS data feed (pilot plug) could be a solution.
4. Battery Life
   i. Minimum run time on batteries alone should be not less than 10 hours but are typically longer due to lower power requirements of

single antenna systems. Port specific requirements may necessitate longer run times or interchangeable batteries.

5. Weight
    i. Gross weight should not exceed 3kg

Software

Mandatory requirements

1. Software Design
    a. Designed for precision pilotage and berthing
    b. Display a customisable ship predictor based on independent heading, CoG, RoT, SoG, drift and optionally a roll sensor
2. Alarms
    a. Display an unambiguous visual and audible warnings when position and/or heading accuracy falls below a set threshold or there is any other threat to the integrity of the displayed data
    b. The software must have robust performance monitoring and error display, and be configurable by the user
3. Charts
    a. Must be capable of displaying official electronic charts (ENCs)
4. Routes
    a. The software must be capable of displaying full route information equivalent to that of an ECDIS, including waypoints, turn radius and cross track margins
5. Tides
    a. The software must be capable of making allowances for tide height. This can be manual, automatic (based on predictions) or in the best case, live data
    b. It must be obvious whether the displayed depth contours include or exclude tide height (as in ECDIS).
    c. The software should be capable of displaying safe navigable water based on ship's draught, UKC allowance and height of tide.
    d. The software should be capable of integrating with a live UKC feed
6. Playback feature
    a. The software must have the ability to playback past recordings

Suggested requirements

1. Docking Mode
    a. Specific docking/berthing information display
    b. Indicate ship's speed along longitudinal & athwartships axis (bow and stern)
2. Meeting Points
    a. Have the ability to display meeting points on same route by ships on reciprocal courses, taking account of multiple legs (using AIS data).
3. Docking lines
    a. Have the ability to define and select docking lines showing the distance from the ship to the berth or any other designated feature
    b. Have the ability to toggle between knots, m/sec or cm/sec for closing speeds
    c. A docking speed alarm
4. Recording

    a. The software should automatically record on start up.
5. Voice and video
    a. The software may be capable of recording voice and optionally video.
6. Bathymetric Charts and Overlays
    a. Have the ability to display Bathymetric Electronic Charts (bENCs) and engineering drawing files (such as dwg, dfx)

PPU Class C: Ship Dependent Navigation Systems

These systems only augment and refine the ship's gyro feed to give independent rate of turn. Position, speed and heading are derived from the ship via the transmitted AIS signal or the pilot plug and display on professional PPU software. They are only suitable for general navigation pilotage and should not be relied upon for narrow channel or berthing operations.

CAUTION - this technology is NOT recommended by AMPI for port pilotage, pilotage in confined waters or in situations where high accuracy position information has been assessed as a requirement. This method relies on the ship's AIS equipment and is subject to

1. position latency
2. lack of differential corrections
3. offset errors

Hardware

Mandatory requirements

1. Refined Heading
    a. An internal rate gyro, or similar technology to refine the ship's gyro heading to a tenth of a degree to produce independent RoT calculations with an accuracy in the region of 0.5 degrees/min
2. Auto Tx Pin Detection
    a. The unit must be able to detect and correct faulty AIS plug wiring

Suggested requirements

1. Wireless transmission to PPU display
    a. Utilising either Bluetooth or WiFi to transmit the position, heading, AIS and RoT data to the pilot's laptop/tablet
    b. Performance integrity monitoring and notifications of any interruption to the AIS signal
2. Battery Life
    a. Minimum run time on batteries alone should be not less than 10 hours but nonetheless be sufficient for the intended duration of the pilotage. An external power supply or additional batteries should be considered
3. Weight
    a. Gross weight should not exceed 0.5kg

Software

Mandatory requirements

1. Software Design
    a. Designed for professional piloting use
    b. Display a customisable ship predictor based on independent heading, CoG, RoT, SoG, drift and optionally a roll sensor
    c. Have the ability to correct erroneous AIS antenna offsets.

2. Alarms
    a. Display an unambiguous visual and audible warnings when position and/or heading accuracy falls below a set threshold or there is any other threat to the integrity of the displayed data
    b. The software must have robust performance monitoring and error display, and be configurable by the user
3. Charts
    a. Must be capable of displaying official electronic charts (ENCs)
4. Routes
    a. The software should be capable of displaying full route information equivalent to that of an ECDIS, including waypoints, turn radius and cross track margins
5. Tides
    a. The software must be capable of making allowances for tide height. This can be manual, automatic (based on predictions) or in the best case, live data
    b. It must be obvious whether the displayed depth contours exclude tide height (as in ECDIS) or include it
    c. The software should be capable of displaying safe navigable water based on ship's draught, UKC allowance and height of tide
    d. The software should be capable of integrating with a live UKC feed
6. Playback feature
    a. The software should have the ability to playback past recordings

3. PPU EQUIPMENT & SOFTWARE SPECIFICATION

Overview

Having separated the Very High and High Precision Berthing PPU systems from the low accuracy Navigation Systems and identified the risks in relying solely on the AIS for position, the next step is to look at the equipment itself.

The main components are

- Display Device
    - Laptop/tablet

- PPU Software
    - Takes the raw NMEA data and converts it into a user interface display
    - The display software is also usually responsible for collating the necessary data for displaying a predictor

- Position Sensors
    - One or more GNSS receivers ideally utilising a minimum of two or more satellite constellations

- Independent Heading
    - Sensors utilising long baseline or carrier wave phase shift methods for resolving independent heading. This may be augmented by an internal rate gyro

    - The long baseline method requires a reasonable separation of antenna to achieve accurate heading, in the region of 20m
    - Phase shift method uses the doppler shift of the carrier wave frequency coupled with a known and exact distance between the antenna. An approximate minimum distance of 1.5m is required for accurate heading calculation. The more satellites in view, the quicker heading is established and the more stable it is.

- Processor/Controller/Other Sensors.
    - The processing unit may be housed separately or incorporated into the receiving antenna. This element processes the sensor inputs, handles communication between the components and outputs the data to the laptop/tablet wirelessly. It also takes in information from any other sensors like AIS, IMU, RTK or other correction methods, processes it and applies it to the output display.

- Rate Gyro or Rate of Turn Generator
    - Used in non-independent systems to refine the vessels gyro output.
    - Used in independent heading systems as a comparator.
    - Can take the place of processor/controller transmitting data to the device

PPU Display Unit (Laptop/Tablet)

Displays must be selected appropriate for the pilotage application, from ultra-lightweight tablets, rugged laptops to hand-held devices. Standardisation is desirable within a group.

- Battery runtime must be sufficient for the expected pilotage length. Spare batteries or external power supplies should be considered where appropriate. It should be noted that one of the most power hungry aspects of the display is the selected display brightness. Reducing the brightness slightly can have a major impact on battery life. Manufacturer's quoted runtime should not be relied on and real world testing should be used to assess actual battery life.
- Each pilot may have their own dedicated display unit or at least have familiar default settings if the software does not provide individual user profiles for pilots to log into.
- Whether the PPU display units is dedicated to that purpose alone or used as a multi-purpose device is a decision to be made by the pilotage provider with due consideration to the risks/benefits of each option.
- Ability to dim the night screen to a point where it does not interfere with the night vision of personnel on the bridge.
- Display units used outside a protected environment for berthing assistance must be viewable in bright sunlight.
- Display units used outside a protected environment for berthing assistance should be weatherproof and capable of operating at extreme temperatures.

Accuracy

Very High and High Accuracy PPUs provide a powerful addition to the eye during precision berthing operations where landing speed must be carefully monitored.

The availability of SBAS, RTK and other shore-based position correction systems have given a major boost to precision piloting systems. The high accuracy and compact unit size available in Class B PPUs make them a very popular lightweight option with positioning accuracy comparable with Class A.

Whilst on the face of it centimetre accuracy may seem excessive, it is not just the position information that is of value. It is the fidelity of the prediction and the motion of the ship’s extremities that are enhanced by this high precision. Higher precision means less smoothing and more accurate motion prediction.

The Positioning/Heading Sensor

The most significant issue with carrier wave phase measurements (the basis of heading calculations) is multipath error. To avoid both multipath and other interference, good siting of antennae is important and a clear view of the sky essential.

Transmission between the positioning/heading sensor, processing unit and display unit is currently either Bluetooth or WiFi. There are advantages and disadvantages to both of these wireless technologies. WiFi is reported to be subject to more interference but has the advantage of longer range while Bluetooth is reported to be more stable but has less range. Bluetooth draws less power than Wi-Fi.

Antenna setup and the connection to the laptop must be simple, able to be done in the dark and take no more than two minutes.

PPU Software

PPU software falls into two main categories.

1. Of the shelf software, designed to be compatible with many types of PPU hardware.
2. Proprietary software which is designed to be used exclusively with a particular brand of hardware,

Should you select hardware which uses proprietary software you need to be aware that you are stuck with that software for the life of the unit. You must therefore be careful to ensure that the software meets the needs of your operation. Conversely, proprietary software may offer features or capabilities specifically designed for the hardware it’s paired with and therefore may be a better choice

PPU software is now becoming less standalone and more networked. Charts, updates and routes can be updated and distributed from a central server rather than having to be applied to each laptop individually. Internet connectivity is increasingly becoming a requirement of normal software use. Indeed, it is not unusual for the software to be polled over the internet to comply with license requirements.

Motion Prediction

PPU software for Class A and B must provide a visual presentation to user, of the vessel's predicted future position. This prediction, to be of any use, must be based on a number of pieces of data including COG, SOG, RoT, longitudinal speed, drift and roll.

It is important that Pilots understand that the predictor is not intelligent. It depicts an instantaneous display of the likely position of the ship with the assumption that nothing changes. Given that it is based on historical data, the predictor itself is also marginally historical in its derivation.

Speed Over Ground vs Ship Speed (2D)

It is imperative when Class A/B software is providing docking information that the ship's speed is displayed longitudinally and athwartships. Furthermore, the speed athwartships of the bow and stern of the vessel should be differentiated. Ship's speed should be displayed both numerically and graphically (vector line).

This is opposed to the default speed over ground (SOG) vector which indicates the speed of the travel of a defined point on the vessel – irrespective of ship's heading and rate of turn. SOG when manoeuvring can be misleading, and this Code hopes to highlight the absolute need for actual vessel motion to be displayed. Additionally, the ship's motion as viewed from the berth is also possible (see fig 1). That is, the ship's bow for example, may be swinging away from the berth but the vessel overall is closing. It should be noted that not all PPU software is capable of providing this critical information.

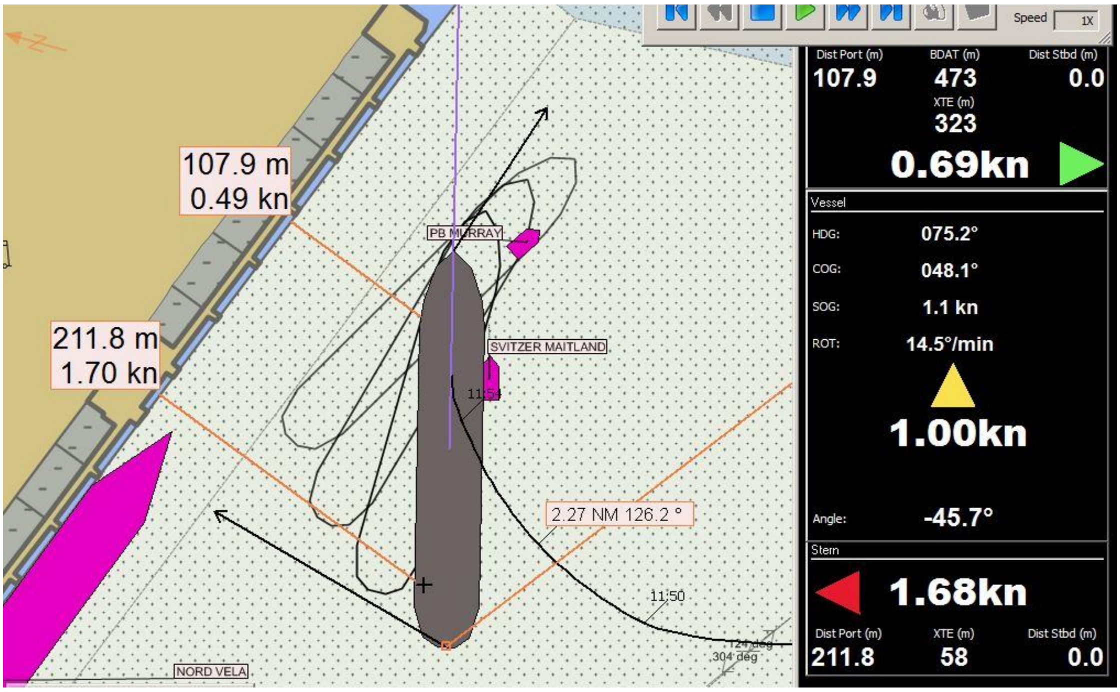

Fig 1. Despite the bow moving to starboard at 0.69kts, viewed from the wharf it is still closing at half a knot.

Safety Alerts

In addition to the software requirements the following safety related criteria should apply to all PPUs:

- Software must display an unambiguous visual and audible warning when position accuracy falls below a set threshold
- Software that reverts to DR mode, even for short periods, must immediately alert the pilot
- Software must be configurable so that a pre-selected default display, scale, route and layout will appear every time on start up with the minimum input from the pilot
- Software that is set up to allow user selectable layouts must have a default setting. This default setting should be the Standard Mode to revert to known setting parameters
- Integrity monitoring of positioning data, from whatever source, is essential
- Ability to record voice with PPU data is a great benefit for training, debriefing, conducting checks and incident learnings
- PPU data should be protected and archived

These basic recommendations should provide a safe platform and reduce known risks without becoming overly prescriptive and stifling innovation.

Weight

Class A equipment is typically larger and heavier than dependent heading systems due to the requirement for two sensors (position and heading) and a differential corrections receiver.

With the advent of satellite based augmentation and miniaturisation in general, size and weight have reduced considerably in all equipment categories. With differential corrections being available through the internet, some smaller and less expensive equipment can be very accurate indeed.

Equipment weight is a serious consideration as Pilots will be reluctant to carry heavy gear day in, day out. Excessive weight may also lead to health and safety concerns while transferring equipment between the launch and piloted vessel.

Equipment weight is primarily a problem for older Class A equipment, however there are High Precision Berthing Systems now available that weigh in at less than 2kg (without laptop).

In the Class B equipment category well established PPU suppliers have sensors weighing less than 1kg which come with a high level of accuracy with the addition of SBAS and/or RTK.

Set-To-Work

Set-up time for any PPU equipment should be no more than a few minutes in the hands of a well-trained pilot. The laptop computer should be capable of being prepared with ship details in advance and left in standby mode until needed. The automatic population of ship details from AIS is increasingly a facet of quality software and is a good time saving feature.

Portability

The PPU bag or case should be fitted with snap hooks to allow securing to the pilot boat and quickly attaching to the heaving line during transfers. The carry case or bag should be waterproof, buoyant and have retro-reflective tape applied to each side. Bags have the advantage of being lighter than cases and less likely to cause injury to those on the launch as well as the ship's crew having to heave the equipment up the ship's side. For this reason, bags are favoured for transfers to and from launches.

Reliability

PPUs from reputable suppliers are designed to be reliable and robust.

In some cases, pilots have unwittingly ended up with equipment that is poorly designed or unsuitable. The combination of GNSS, WiFi, UHF, DGPS, AIS and RTK signals squeezed into a small case can create signal "noise" problems that can result in erratic and unreliable service. Interference has been also known to occur from port communication radio links in poorly designed equipment.

Pilots faced with unreliable equipment will soon lose confidence, and therefore interest. It is imperative that extensive trials are done before acceptance.

- Logbooks should be kept of PPU use and faults noted.
- Maintenance should be planned and documented.
- Unreliable equipment should be repaired or replaced promptly.
- A designated person should be responsible for scheduled maintenance.

The Pilot Plug Connector

When connecting to the pilot plug for the purposes of obtaining ships heading, the use of a wireless connection is recommended. Benefits include protection from an electrical spike damaging the display unit in the event the pilot plug is wired incorrectly. The wireless connection has the major advantage of allowing unfettered movement on the bridge and allow the PPU to be located in the most convenient conning position.

- The pilot plug connector should have the ability to indicate the pilot plug is operational and, when necessary, correct any wiring anomalies.
- Battery life must be adequate for the intended pilotage

It is recommended that AIS data not be relied on for positioning and that it always be augmented by an independent GNSS position input.

Compass Safe Distance

PPU equipment should be labelled with 'Compass Safe Distance' for those rare occasions when the heading and positioning sensors used with Class A equipment are deployed on the monkey island and placed within 5m of the magnetic compass.

- PPU manufacturers should provide compass safe distance information.

Intrinsic Safety

On tankers, the bridge and bridge wings are designated safe areas. As long as the PPU does not transmit at power in excess of 1 watt there should not be an issue with intrinsic safety.

- PPU manufacturers should be required to provide transmission power output details to comply with equipment use in the safe area of a tanker.

Common Operating Picture

It is now possible for the pilot's PPU information to be shared in real time with third parties. For example, a VTS, Harbourmaster, tugs, or an incident control centre. Fully integrated port wide systems which allow for the real time sharing of this information are already available. It can also be done with widely available screen sharing software at virtually no cost. This opens up a whole range of opportunities for improved safety but also introduces new risks and distractions which should be carefully considered and incorporated into policy.

Policy

The pilotage safety management system is the obvious home for policy and procedure around PPU.

PPUs clearly add to a pilot's situational awareness and their use should be strongly encouraged. However compulsory carriage for example, whilst an admirable goal, requires a variety of elements to be considered. For example, training (setup, working use, technical understanding, troubleshooting etc), certification (record keeping), ongoing competency assessment and guidance around equipment failure.

All of this should be captured in the pilotage provider's safety management system, along with the relevant procedures.

As mentioned earlier in this document, decisions need to be made around whether or not the laptop/tablet is dedicated to PPU use, or is allowed to be used for other pilotage related tasks (e.g. weather, scheduling, eMPX). Individual issue versus common user equipment should also be a conscious decision.

All of the above should be considered in the context of the specific pilotage needs and the risks of the port in question.

4. CHARTING (see Appendix 2 for Definitions)

Charting used should provide the highest level of accuracy available. There are a range of different chart options, however for pilotage purposes the official Australian Hydrographic Services (AHS) Electronic Navigation Charts (ENC) should be used unless a more suitable alternative exists. Privately produced charts are also acceptable and may provide an excellent solution, however there are additional considerations with these charts.

1. Ongoing updates. Is the charting company capable or has it been engaged to provide updates?
2. The ship will not have the same chart on their ECDIS.

Updating

This is the final piece of the PPU jigsaw. All the good work done on equipment selection and training can be undone in an instant if the displayed chart is out of date. Keeping charts up to date across multiple devices is a challenging area. Systems must be developed to ensure this is done regularly. Failure to do so may result in liability issues for the pilotage provider in the event of an incident.

Suitable Charts.

- Where Official ENCs exist and are sufficiently detailed, these are the preferred charts.
- Just because charts are "Official", do not assume they will be absolutely accurate until thoroughly checked – particularly in confined water. Zones of Confidence (ZOC) should be known and their associated uncertainties taken into account during planning and piloting. For completeness have a hydrographic surveyor check accuracy.
- Official ENCs sometimes do not have sufficient detail for port pilotage. The accuracy of individual ENCs is indicated by their Nav Purpose number.

A. Nav Purpose 6 denotes Berthing levels of detail.

B. Nav Purpose 5 is Harbours and Approaches.

C. Nav Purpose 3&4 is for Coastal Navigation.

- The third character in the ENC chart title is the Nav Purpose indicator. AU5******.*** indicates this is a Nav Purpose 5 (Harbours and approaches) chart.
- Level 5 ENC charts exist for pilotage purposes and are available from the Australian Hydrographic Services. At time of writing, Level 6 Berthing ENCs are being produced for some ports.
- Ideally the Pilot PPU and the ships ECDIS will be using the same highly detailed ENC.
- The lack of commonality should not be allowed to preclude the use of higher quality information when it is available to the Pilot, but all parties need to be aware of any differences that may be present.

- Official Pilotage ENCs with at least 1m density contours, 50m spaced soundings, 4000 compilation scale and no dredged areas with maintained depths should be aimed for use with PPU class A & B.

In Summary

- Always use the most accurate charts possible.
- Keep charts up to date.
- Nominate a responsible person to monitor chart developments and manage updates.
- Use Official Charts whenever possible.

5. TRAINING

Without proper initial training and ongoing refresher training/assessment the true benefits of PPU equipment may well go unrealised. Incidents where PPUs have been available but not utilised indicate that there is disconnect between some pilots and the enhanced situational awareness that PPU provides.

In spite of the absence of a specific regulatory requirement that a pilot be trained in the use of a particular piece of equipment, the inability to competently use an available resource, particularly one brought aboard by the pilot, has the potential to constitute negligence.

ECDIS training provides a good grounding in the basics of electronic navigation and satellite positioning. AMPI recommend all pilots have this as a foundation certificate.

Pilots should undergo specific training on their equipment and software prior to use on the water. The manufacturer, a third-party trainer or an instructor pilot should deliver this initial training.

After initial training, ongoing currency should be maintained by using the PPU in challenging conditions in a bridge simulator. Such advanced training would be “in context” and would include abnormal scenarios where either the PPU or shipboard sensor accuracy degrades. On completion, the pilot should be familiar with the equipment, competent in its use, be able to cope with abnormal situations and troubleshoot basic problems.

Pilots should receive supplemental instruction any time their hardware or software configuration has undergone appreciable change. Formal training on the PPU equipment should be incorporated with regular checks and skill updates.

Training should address the following:

- Pilotage providers need to comply with PPU training as required by the industry regulator.

- In the absence of specific regulatory training requirements, the pilotage provider needs to provide evidence of formal training and periodic PPU competency checks.
- Prior to using a new PPU the pilot should receive initial equipment specific training.
- After a familiarisation period the Pilot should be able to demonstrate the required level of competency. At this stage the Pilot can be given advanced training and further competency assessments.
- During scheduled simulator training, PPU should be incorporated into the exercises. Consideration should be given to specific PPU exercises involving blind pilotage, recognition of sensor degradation and troubleshooting.
- Pilots should be given PPU refresher training and checks incorporated into periodic peer assessments or pilotage checks.
- Whenever possible, PPU instructor pilots should be appointed from within the pilot group. These PPU instructor Pilots should initially receive extensive equipment specific training to equip them with the skills necessary to train and assess their colleagues.

6. STANDARDISATION

It is essential that all systems in a given pilotage area are as uniform as possible, contain and display the same waypoints, routes, and aids to navigation. In more extended pilotage areas, several routes may be appropriate. Changes are inevitable as skills and equipment are developed and more experience is gained. It is important that standard operating procedures are updated to reflect changes once new practices have been agreed upon and formally adopted.

Standardisation of equipment, training and procedures will produce the most consistent outcomes.

7. LIABILITY CONSIDERATIONS FOR PILOTS

Pilot services around the world have considered the issue of liability and the use of PPUs. The best protection against liability is to do the best possible job you can while piloting. Pilots should do whatever they can, and use whatever resources are available, to prevent an incident.

If an incident does occur, the law favours those who can show that they did their best rather than those who tried to avoid liability. It could be argued that there may be a case to answer should a PPU have been provided but not used, if it may have prevented an incident. Indeed, there have been several such cases in recent history.

Consider the following recommendations:

1. Receive formal training before using any PPU.
2. Develop a deep understanding of PPU functionality.
3. Integrate the PPU into your visual pilotage.
4. Align visual marks and wheel over points with the electronic passage plan
5. Develop systems for ensuring all units have up to date charts
6. Beware of over reliance or screen fixation.
7. Carry spare batteries and other ancillary equipment that may be needed.
8. Makes sure the system is working properly with routine checks.
9. Establish a system of periodic maintenance checks. Keep a log of usage and faults.
10. Consider placing ownership of maintenance with a separate, limited liability entity.
11. Do not use PPU equipment that is not sanctioned by the pilotage provider and/or authorised by the regulator.
12. Undertake all available training including blind pilotage exercises.

8. LIABILITY CONSIDERATIONS FOR PILOTAGE PROVIDERS

If it can be demonstrated that the use of a PPU may have prevented an incident, and that the pilotage provider has not supplied suitable equipment or training, there is potential for the provider to be held accountable. As PPU use is now widespread it can be deemed as good practice.

Clearly liability risks increase when a pilot is simply handed a PPU and dispatched to a ship without the complete framework provided by policy, procedure, training and updating.

9. SUMMARY

It is without question that the proper incorporation of PPU in pilotage adds to a pilot's situational awareness. This is especially true at night or where visibility is reduced. Its value in unplanned and abnormal events cannot be overstated. Due to these reasons alone, safety is improved and the likelihood of incidents reduced. The evidence in this regard is irrefutable, therefore the correct selection of equipment, software, training and skill maintenance must be a high priority for any pilotage service provider.

Used correctly, the PPU is a valuable addition to the existing navigation tools available to the Pilot and provides invaluable support to human perception.

10. REFERENCES

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11. APPENDIX

Charting definitions

Electronic Charts

ECDIS (Electronic Chart Display and Information System) – highly sophisticated navigation systems designed for ships. This equipment standard involves both hardware and software. Conforms to strict international standards.

ENC (Electronic Navigational Chart) – vector chart database published by a national hydrographic office for use in ECDIS. Meets international standards set by the IHO (International Hydrographic Organization) and IMO (International Maritime Organization).

S57 and S63

ENC data is arranged according to S57 format and specifications.

S57 – The IHO data format and specification which governs the content, creation and display of ENCs.

S63 – The IHO ENC data protection (encryption) scheme

Raster and ECS

RCDS (Raster Chart Display System) – a mode of operation for ECDIS which uses official raster charts (known as RNCs) in areas where ENCs have yet to be produced by Hydrographic Offices.

ECS (Electronic Chart Systems) – non-ECDIS chart navigational systems, some of which come close to ECDIS performance.

Bathymetric ENC's

These bENC's are becoming available when Hydrographic offices utilise bathymetric data to produce high density ENC's

The main features of these bENCs may include:

- 1:2500 compilation scale
- coverage based on the availability of high-density survey data
- depth contours at 1m interval, soundings with a 50m spacing, and essential Navaids

The ENC Story

An Official ENC, or Electronic Navigational Chart, is an official vector electronic chart produced in International Hydrographic Organization (IHO) S57 Edition 3.1 format and protected using the IHO S63 data protection scheme. It is authorised for use in International Maritime Organization (IMO) compliant Electronic Chart Display and Information Systems (ECDIS) and can also be used in compatible Electronic Chart Systems (ECS). Please note that "S57" is an IHO transfer format and is not an official ENC. Anyone can produce "S57" formatted data but only the official ENC complies with SOLAS requirements and carries the warranty of a National Hydrographic Office.