IALA Workshop on Developments in Floating Aids and Associated Moorings

1 – 4 April, 2008

Final Report

Executive Summary

An IALA Workshop on Developments in Floating Aids and Associated Moorings was held from 1 to 4 April 2008, at Le Quartz Centre de Congres, in Brest, France.

Seventy-six delegates from twenty-six different countries attended the workshop.

The workshop began with a series of presentations on moorings, structural issues and visual issues relating to floating aids to navigation. Delegates then viewed several buoys placed on the quayside, visited two buoy tender vessels and witnessed a demonstration of a hot welding repair technique for polyethylene.

Subsequently, delegates discussed moorings, buoy maintenance, visual aspects and plastic buoys in separate working groups. They reviewed existing IALA guidance documents and developed new guidance documents.

The workshop provided an excellent opportunity for delegates to discuss various aspects of floating aids and moorings, in both formal and social settings.

The workshop identified 14 conclusions and 13 recommendations.

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Introduction

A workshop on developments in floating aids and associated moorings was held from 1-4 April, 2008, at Le Quartz, Centre de Congres, in Brest France. Seventy-six delegates from twenty-six different countries attended the event.

The four day event attracted representation from various national administrations and IALA Industrial Members. An exhibition displaying some of the products available from IALA Industrial Members, was held in parallel with the workshop.

Day One – Opening and Presentations on Moorings and Visual and Structural Issues

Session 1 - Opening of the seminar

Chairperson – G Caude, France

Opening remarks by G Caude

G Caude, Director CETMEF (France), opened the workshop. After welcoming the delegates and setting the scene for the workshop, he provided an overview of CETMEF. This included a breakdown of its tasks and responsibilities and stressed the very strong links with IALA, which covered the e-NAV, EEP, ANM and VTS Committees. There was reference to how CETMEF and its predecessors had helped shape developments at IALA, including the provision of considerable expertise on topics ranging from buoyage to AIS. In conclusion, G Caude provided a list of the points of contact within CETMEF for different issues.

Welcome by J Manchard (Directorate for Maritime Affairs, France)

J Manchard welcomed all delegates and expressed warm sentiments concerning France's support for IALA. The tasks of the Directorate were outlined, with a focus on its goals with regard to aids to navigation. Specific mention was made of improvements in buoyage, including transportability and moorings and the use of new materials in their construction.

Welcome by M Alimchandani (IALA)

Acting on behalf of the IALA Secretary-General, M Alimchandani thanked both CETMEF and the Directorate for Maritime Affairs for their support in planning and preparing for the workshop. He then presented an IALA plaque to G Caude. Appreciation and thanks were expressed to the delegates for their participation and to the IALA Industrial Members for their contribution to the exhibition. In conclusion, M Alimchandani offered best wishes for a productive and enjoyable workshop. He then read out a message from the IALA Secretary-General, T Kruuse, who was unable to attend.

> *Mr T Kruuse sends his apologies, as he is unable to be with us today. He has asked me to thank the French administration on his behalf, for hosting this workshop and for all the effort that has gone into organising it.*
>
> *He would like to thank each of you for taking the time to participate in this workshop and to the IALA Industrial Members for their support of the exhibition.*
>
> *The last IALA workshop on floating aids was held in Ireland in 1984. Well, 24 years is a long time between workshops on the same topic. Stating the obvious, there have been considerable developments since then.*

Technology has improved vastly – for example, buoys made of materials other than steel, are now available. And it is incumbent upon IALA to offer up-to-date guidance to its membership.

Mooring systems are of particular interest to our members and you will see that an entire session and a working group have been devoted to this topic. You will hear about the cost comparison of buoys, innovation in paint technology, dealing with marine growth and visual aspects of buoys - a presentation-packed day awaits you.

Finally, Mr T Kruuse sends his best wishes for a both a productive and enjoyable workshop.

Referring to the final workshop programme, M Alimchandani made various administrative announcements.

Health, Safety and Administration Brief (J Tourbot, CETMEF)

J Tourbot of CETMEF provided delegates with a briefing on health, safety and administrative matters, including the need to follow the SORTIE (EXIT) signs, in case of an emergency.

Session 2 – Moorings

Chairperson – Omar Eriksson, Denmark

Method of extending the life of Moorings (Adrian Wilkins, UK)

A Wilkins presented information on the mechanism of chain wear and stated that managing this was important. He showed many examples of chain wear in steel mooring chains. He emphasised the importance of mooring specifications (using quality control in mooring chains and using steel with high manganese content) and accurate record keeping in the planning of cost effective mooring maintenance. A Wilkins also discussed the disposal of discarded chains.

Elastic Moorings (Sipke Hoekstra, The Netherlands)

S Hoekstra stated that the overall aim was to reduce the maintenance interval for mooring systems. He then outlined the many benefit of rubber moorings, including trials that had taken place in The Netherlands since 1997. S Hoekstra gave some practical details of elastic moorings, including examples of fouling. It was noteworthy that in almost all conditions, the load on elastic moorings was a fraction of that on conventional chain moorings. He concluded by listing the many benefits of elastic moorings. These included:

- light in weight
- ease of assembly
- doesn't damage the seabed
- more resistant to marine growth
- water depth has no influence
- high positional accuracy
- force is approximately half of that on a steel chain mooring
- life cycle cost is much less than steel chain mooring (and life is almost double that of a steel chain), and
- it requires almost no maintenance

MOORSEL Program in US (Wayne Danzik, US)

W Danzik started by stating that it was vital that the length of mooring chain chosen was 'correct'. Previously, judgement of USCG staff was relied upon. Then, in 1978, the USCG standardised a method to calculate the length of chain. A manual, called Buoy Mooring Selection Guide for Chain Moorings was created. This allowed a user to compute the length of chain. In the 1990's, the USCG started to develop a computer software program, termed MOORSEL (Computer Aided Mooring Selection Guide), to calculate the optimum length of mooring chain. W Danzik then described in some detail the salient features of the MOORSEL program.

In summarising, W Danzik stated that MOORSEL increased the speed and accuracy of mooring design. An engineering background was not required for its use; however MOORSEL was based on standard USCG equipment. It is a tool to augment – not replace - judgment and experience.

Synthetic Moorings (Peter Davies and Nicolas Auger, France)

The first part of the presentation (by P Davies) discussed the materials used and the behaviour of various synthetic moorings. The second part (presented by N Auger) looked at their use in aids to navigation.

P Davies listed the various materials in use (e.g. polyolefins, polyamides, polyesters, HMPE's, liquid crystals, aramids and Vectran), the choices for construction and the methods of securing the termini. He stated that quality control was very important, as there was large variation in performance. As regards behaviour, he discussed mechanical damage, damage due to ultra violet radiation and hydrolysis.

N Auger discussed their application in aids to navigation. He cited deep (depth>80m) moorings, bigger buoys and use in some complex maintenance operations.

Tests over six years in the Mediterranean Sea had proved to be successful. Further, no problems were reported with a mooring in the Atlantic Ocean, even after a severe storm (140 km/h wind and 15m waves). All else being equal, buoys moored with synthetic moorings will move more than that moored by a chain mooring, he stated.

N Auger concluded by stating that synthetic moorings were valuable for some specific applications. Whilst there were no direct financial gains, there were potential indirect cost savings for installation and maintenance.

Ring Sinkers Developed by SMA (Sven Kurin and A Gelbort, Sweden)

S Kurin and A Gelbort presented information on mooring systems for lightbuoys with extended service periods, with an emphasis on ring sinkers. S Kurin stated that the Swedish Maritime Administration had, for several years, successfully used ring sinkers (2–3 tonnes in weight) for mooring of exposed lightbuoys.

Ring sinkers were cost effective. They could be used with great success in areas that had difficult holding ground, e.g. soft mud, sand and clay. The holding capability was far better than mushroom anchors.

Buoys that had typically a long history of drifting out of position each winter are rendered stationary by ring sinkers. Considerable savings are gained by this mooring method, including the avoidance of high risk (and difficult buoy retrieval) operations in drifting ice.

S Kurin concluded by discussing the PU wear protection on buoy main shackle.

A Gelbort discussed a typical sinker assembly for lightbuoys with rubber wear section in the trash zone. He also discussed the use of synthetic moorings in sheltered waters, including details of all the components.

A Gelbort concluded by detailing the mooring method in narrow fairways with rock and very soft seabed.

Inspection of Mooring Chains (Wayne Danzik, US)

W Danzik stated that the open link, low carbon steel mooring chains were the preferred metal chains. USCG staff often visited factories and carried out visual inspections and break load testing. He also gave example of typical chain moorings.

As regards the methods of inspection, he stated that callipers were used to measure the smallest diameter of the most worn links. Measurements were made to 1/32". A chain was replaced

when it reached the minimum wear measurement for that buoy type. He also outlined the criteria for inspection intervals and the replacement criteria adopted by the USCG.

In summarising, W Danzik stated that it was important to ensure quality at the source, keep accurate wear records, implement a performance-based inspection regime and extend inspection intervals where possible.

Conventional Chain Moorings (Guy Marit, France)

Guy Marit provided an overview of Marit Davaine Chaines, a privately owned company in France, which had over 260 years of experience with buoy mooring chains. He provided information on the various products of the company.

G Marit then outlined the comparative study undertaken by Marit Davaine Chaines on the various coatings for buoy mooring chain. He outlined the various parameters of the cycling corrosion testing. He concluded by stating that the major problem was corrosion in the interlink area.

Session 3 – Floating Aids – Structural Issues

Chairperson – Adrian Wilkins, United Kingdom

France's experience with Plastic Buoys (Guy Cunty, CETMEF)

G Cunty began by saying that his inclination was for the use of modular buoys and he refuted any allegation that buoys were becoming redundant, other than as a platform for seals. He outlined the context of his paper, which went back some fifteen years, when the buoy tender vessels and buoy design were in excess of fifty years old.

Bringing the equipment up-to-date started with the introduction of off-the-shelf modular buoys, for which he gave the main objectives. 450 of these buoys had been ordered or already procured. This was followed by the introduction of new tenders of 3 different sizes.

The advantageous changes introduced in the buoy designs were covered, including buoyancy, buoyancy support, bird repellence and colour stability. Buoy mast design had been thoroughly overhauled and had resulted in major changes, including high visibility and maintenance capability. It was remarked that the outcome of the CETMEF study was available from the IALA website.

Conclusions drawn, following the use of plastic buoys, covered:

- Improved safety of handling and maintenance
- Need for smaller tenders with limited crane capability
- Modularity mad transport and storage easier and cheaper
- Perfectly matched with other new technologies (LED, solar, etc.)
- Great homogeneity of life-span of all the components and equipment
- Long life at sea (more than 15 years)
- Reconditioning required lighter and safer equipment
- High reliability allowed reduction in the non scheduled interventions to a minimum

Finally, despite lesser experience as compared to that with steel buoys, lack of a rigorous cost comparison study and a lack of significant failures (which would have impacted on the concept); CETMEF is convinced that modular buoys are the way of the future.

Marine Growth on Buoys – A Case History (Wayne Danzik, US)

The scene for the 'detective story' that unfolded was Tampa Bay in USA, where, in 1999, steel buoys began to sink in noticeable numbers. Quality control in construction and paint were found to be sound and the waters in which the buoys were laid were not found to be exceptional. The cause emerged from a casual mention, by someone on a buoy tender, of the sudden appearance of green mussels, which, in the waters off Florida, are an invasive species from tropical waters. Investigation showed that the mussels colonised the buoys; first stripping away the paint and thus exposing the bare metal. Coupled with this was a corrosive secretion, resulting in holing of the buoy hulls.

Improved paint and more regular cleaning proved impractical; therefore an ionomer foam buoy construction was introduced. The mussels don't like these buoys and the 'case' was able to be closed.

Plastic Material – focus on life span (Francois Juniet & Michael Ozannat, Mobilis)

F Juniet introduced Mobilis by saying that the company was formed in 1990 and produces a wide range of standard and specific buoys. The characteristics of the product range were then introduced, noting that there has been a move from metal to polyethylene (PE) construction.

M Ozannat then outlined a recent Mobilis study on buoyage, which concluded with the recommendation that PE be used. The tests that the new PE buoys were subjected to were itemised and the experience to date with the material was given. This included the outcome of tests for colour brightness, colour evolution and colour oxidation. The tests showed increased UV resistance.

In conclusion, several examples of current buoy usage and wear were given.

Paint Protection - A coating system for the future (Ron Blakeley, UK)

The presentation focussed on the protection of steel buoys. The aim of the project being presented was to find a protection system that would extend the maintenance cycle to 10 years, thus producing considerable savings. The outcome presented was a joint product of work from three General Lighthouse Authorities (Commissioners of Irish Lights, Northern Lights and Trinity House). It was emphasised that the starting point, before investigating the required paint characteristics, was a buoy capable of staying at sea for 10 years (mechanically). Having found the answer to be affirmative, the current differences between the approaches of the GLAs was covered and then various options for the way forward given. However, it seemed clear that a '10 year' paint solution was feasible. Environmental considerations, as well as colour and antifouling characteristics were then covered. However, it was stated that all of the work undertaken had to be set in the context of cost and the consequential changes to depot facilities and handling considerations.
The presentation concluded with coverage of the salient points from the long-life paint report produced by Trinity House, with an undertaking to keep IALA updated on future developments.

Experimental Coatings for Aids to Navigation (Colin Bower, Maker Coatings)

The presentation began with consideration of the problems involved when coating a maritime structure, which are inevitable but believed to be controllable. The process for preparation and painting being trialled by Trinity House, as outlined in the previous presentation, was given in some detail. The value of the savings being sought was considered achievable, with life-spans of up to 15 years (25 years for top coats) being contemplated.

It was concluded that the solution being proposed was considered easy to use, minimised waste and was environmentally friendly.

Nearly 100% Plastic Buoys (Sipke Hoekstra, The Netherlands)

The goals of some recent research on the subject were outlined, followed by a brief description of the subsequent trials that had been carried out. The research had led to the development of a new class of buoys, examples of which were then described, with design differences and aspects of testing being highlighted.

The coverage and number of buoys deployed was given, together with the savings achieved in maintenance. The numerous advantages of using wholly plastic buoys was stated, with the conclusion that 100% replacement of steel buoys was possible when deployed inshore – for deployment in open waters, it was approximately 97%.

High Density Plastic Spar Buoys in Ice (Lars Mansner, Sabik, Finland)

Starting with a background of the ice conditions experienced in Finnish waters, which gave rise to the use of plastic spars, brief details of current production and design were presented. Experience has brought forward a new concept, aimed at providing additional advantages from a new design of plastic buoys.

The survival conditions required of the new design were itemised, although it was admitted that putting precise figures to the specified survival characteristics was difficult. This was followed by discussing the minimum performance requirements before aspects of the recently tested, new design of buoys were given.

The presentation concluded with listing the advantages of the design, together with the considerations necessary when deciding where the buoys could be deployed.

Overview – experience with plastic buoys in Australia (David Jeffkins, AMSA)

The introduction of eight plastic buoys, as part of the total Australian buoy outfit, was reported as a recent departure for AMSA. The current maintenance regime was described, with the vastness of the area to be covered being graphically depicted. Requirements in the Spencer Gulf had acted as a spur to trials of new buoys and the requirements, including maintenance and design that arose from this, were given. The details from the submission received, in response to the project tenders, were given. Clear advantages were apparent from the introduction of plastic buoys.

Cost comparison of buoys – Steel v/s Plastic (Christine Clark, Tideland, UK)

It was stressed that 'like for like' comparisons were essential for any value to be gained. The starting point in making a comparison was construction / design. This allowed a sensible capital cost evaluation to be undertaken. Although purchase costs were largely similar for steel and plastic, the additional costs for items such as moorings and maintenance were reduced. Turning to installation, maintenance and use of resources (human and capital) issues, plastic buoys again came out ahead. Environmental issues were considered more equivocal, with the recycling of plastics still in its infancy. Example cost comparison models were shown and the presentation concluded with an offer for the algorithms used to be made available.

Session 4 – Floating Aids – Visual Issues

Chairperson – Seamus Doyle, Ireland

Buoy Stability and Vertical Divergence (Roger Lewis, UK and Omar Eriksson, Denmark)

R Lewis made a presentation on the effects of buoy movement on the detection and recognition of its light. The roll motion of a buoy was analysed to produce a graph of roll attitude, which in turn led to the generation of data on vertical divergence (plotting intensity v/s elevation).

Using the vertical divergence information, the apparently variable range of the lantern was plotted. The effect of waves on the recognition of character was then discussed.

R Lewis concluded by saying that the key was to try and understand what was occurring, so that science could be applied to empirical evidence.

O Eriksson, presenting information on buoy stability and character recognition, explained how Bayesian networks could be used to model static illumination at the observer. Using this model (albeit with many assumptions) three types of vertical divergence could be produced – narrow, medium and wide.

In order to develop a method of quantifying character recognition, it needed to be defined. He then discussed a possible mathematical formula to compute the basic probability of recognition.

In closing, it was stated that roll and list properties ought to be taken into account when selecting vertical divergence of buoy lanterns. Further, buoy roll period ought to be larger than the duration of the signal character used. O Eriksson was of the view that designing lights for use at nominal range was insufficient. Meteorological visibility statistics, vertical divergence and buoy dynamic characteristics etc. ought to be taken into account when determining the useful operational range.

Basic Rules for calculating Static Buoy Stability (Adrian Wilkins, UK)

A Wilkins provided a brief overview of the importance of stability to the aids to navigation function of buoys. Methods of achieving stability were explained and the means of calculating stability explored. The importance of appropriate metacentric height (GM) was emphasised. Basic practical tests to verify stability were also explained. It was well worth doing tow tests, particularly if the buoy was to be deployed in regions with strong currents.

Surface colour and daytime visibility of buoys (Sabina Schollmeier, Germany)

S Schollmeier started by discussing the steps in achieving visual perception. In discussing the elements of day marks, she identified conditions for identification and visibility (object must appear with a certain angle and luminance contrast or colour difference must exist). This led to an overview of the parameters of perception.

S Schollmeier then stated that in order to recognise simple shapes, the human eye needed a separation of at least three minutes of arc to distinguish between two objects or colours. She also discussed de-saturation by the atmosphere and fading of objects.

On the subject of fluorescent and ordinary colours, it was stated that lateral marks with fluorescent colours had the highest recognition distance and were most effective. Fluorescent colours were between 2- 9 times more effective than RAL “traffic” colours. Further, bright and

saturated ordinary colours increased the distance of recognition when compared with RAL "traffic" colours.

S Schollmeier concluded by stating that RAL "traffic" colours (RAL 6024 and 3020) were not optimised for use on buoys. There was a need for a new definition of chromaticity regions for red and green. She recommended that fluorescent colours be use on steel buoys and bright saturated colours ought to be used on plastic buoys.

Radar Reflectors on spar buoys (Risto Joro, Finland)

R Joro's presentation dealt with RCS (Radar Cross Section) parameters and its application in radar range calculations, for the detection of radar reflectors on spar buoys. The Finnish Maritime Administration (FMA) had used eight different types of reflectors on their spar buoys. For the development of one scalable reflector geometria for all sizes of spar buoys, FMA predicts the theoretical RCS of reflectors using software named CAST, developed at the Technical Research Centre, Finland. CAST is based on the Antenna Oriented Physical Optics Method (APO method). It is based on the fact that the scattered field from a target can be determined analytically taking into account multiple reflections, calculating the scattered field and RCS like "group gain antenna" when triangulated target (surface) handled as a conformal group antenna.

The presentation covered measuring types of RCS, calculation basics. The presentation concluded with a statement, the model of the developed reflector and how it ought to be installed on spar buoys.

AIS on Floating Aids to Navigation – Some Practical Notes (Michael Card, Zeni Lite Co. Ltd, Japan)

M Card stated that there were three main roles for AIS when used in association with an aid to navigation. They were to provide a) an electronic indication of AtoN identity and position, b) meteorological & hydrological data and c) AtoN status data. He listed the contents of Message 21 and explained the role of AIS broadcast and addressed binary messages.

In relation to the IEC Test Standard, M Card stated that it was the ship's equipment which would decide how AIS would be displayed. He stated that IEC Test Standard 62320-2 ought to be followed when writing purchase specifications, as it was assurance that the AIS AtoN would meet the international requirements and that the equipment would not interfere with other AIS stations.

M Card explained the difference between the FATDMA and RATDMA methods of accessing the VHF data link. He pointed out that power consumption was lower in case of FATDMA, but an AIS Base Station was required in the radio proximity, to ensure reservation of time slots.

END OF DAY

Day Two – Wednesday, 2nd April, 2008 – Technical Visit to Quayside and Formation of Working Groups

Session 5 – Technical Visit to the Quayside

Delegates were transported to the French Lighthouse Authority depot in Brest, where CETMEF had organised a display of moorings and buoys on the quayside. Delegates were also invited to visit two buoy tender vessels. The large selection of buoys, many of plastic construction and some only recently retrieved from their moorings, were provided courtesy of the French Light House Authority, IALA members and IALA Industrial Members. The buoy tender vessels, which proved to be excellent hosts and answered a wide range of questions, were *Armorique* (France) and *Frans Naerebout* (The Netherlands).

A demonstration of hot-welding repair techniques for polyethylene, provided by CETMEF, aroused considerable interest. CETMEF had also kindly provided refreshments, which proved most welcome as the temperature dropped and rain threatened, but fortunately never arrived.

The tour ended with a visit by two local media reporters, during which a group photograph was taken, after which the delegates were transported back to the workshop venue.

Sessions 6 and 7 – Formation of Working Groups

Based on preferences indicated by the delegates, four working groups were formed. The objective of the working groups was to review and update existing IALA guidance documents and, where required, develop new guidance. The four working groups were:

- WG1 – Moorings (Chairperson: Adrian Wilkins)
- WG2 – Buoy Maintenance (Chairperson: Wayne Danzik)
- WG3 – Visual Aspects of Buoys (Chairperson: Seamus Doyle)
- WG4 – Plastic Buoys (Chairperson: Guy Cunty)

END OF DAY

Day Three – Four Working Groups in Session

Sessions 8 to 11 – Working Groups

Report of WG1 – Moorings (Chairperson: Adrian Wilkins)

WG1 was tasked with combining and updating the existing IALA guidance documents on moorings. These are:

1. Practical notes on the use of mooring chain for floating AtoN (1989)
2. Recommendation on the design of normal moorings E107 (1998)
3. Guidelines on synthetic moorings 1024 (2001)

The third paper is in two sections describing rope and rubber moorings. Before the workshop started, the chairman was able to discuss the existing paper on synthetic moorings with Peter Davies who had made the presentation on synthetic moorings but was unfortunately unable to attend the working group. His views on the existing paper were encouraging.

The members of the group worked extremely well together and were able to bring new mooring expertise to the review of the new draft guideline FA08/WG1/WP1 that had been prepared by the chairman with considerable input from Nicolas Auger who has recently reviewed the calculation of buoy moorings in a variety of conditions. The document was edited by the complete group as the breadth of expertise of many of the members made it impractical to segment into subgroups. Terms and descriptions for various types of moorings and their components were agreed and it was found necessary to provide better descriptions of many design constraints. Problems resulting from ice situations were described and references were made to particular design requirements of inland waterway moorings.

The calculations were reviewed in detail and various errors in units corrected and improvements made in the descriptive part of the calculations.

The group recommended that the calculations should form an annex rather than being in the body of the document to improve “readability”. They will then be with a worked example of calculations for a standard French buoy.

The specifications of chain, shackle and other components were reviewed and updated as necessary. Agreement was reached that detailed material specification is vital to predicting future mooring wear.

The rope mooring section was updated with the considerable experience present. The rubber cord mooring section was explained by Sipke Hoektra who provided details of his extensive experiments with buoys in shallow waters and provided new information to be incorporated in the document.

The considerable extent of the new information provided by the group members prevented an Electronic version of the revised document being completed before the end of the workshop.

The document and the new information will be referred to EEP11 for final formatting and editing.

Report of WG2 – Buoy Maintenance (Chairperson: Wayne Danzik)

The task of WG2 was to update the IALA Guidelines on the Maintenance of Buoys and Small Aids to Navigation Structures (1040) and on Painting Aids to Navigation Buoys (1015), and then to merge them into a single document.

WG2 successfully accomplished this task. The group performed a detailed and comprehensive review of the maintenance guideline and captured extensive comments from all members. The group also merged relevant material from the painting guideline into the maintenance guideline. The group is of the view that painting guideline can be discontinued.

The output produced is a revision of the maintenance guidelines with all comments shown in the "track changes" mode. However, this document will need to be edited with respect to formatting and to properly incorporate all of the comments. The intent is to perform this editing and prepare a final draft during EEP11 (7-11 April, 2008).

It was agreed that there was need to coordinate the development of guidance on maintenance with developments in moorings and plastic buoys.

Report of WG3 – Visual Aspects of Buoys (Chairperson: Seamus Doyle)

WG3 considered input papers FA08-WG3-INF1, FA08-WG3-WP1, FA08-WG3-WP2, FA08-WG3-WP3, and FA08-WG3-WP4. A further input document (a French recommendation on daymark visibility) was provided during the workshop by Xavier Kergadallan.

IALA Guideline on Vertical Divergence and Focal Height of Lights on Floating Aids to Navigation

Input paper FA08-WG3-WP1 (Draft Guideline on Vertical Divergence) was reviewed and revised in the light of the relevant workshop input documents. An output IALA Guideline document (WG3-WP1) on Vertical Divergence and Focal Height of Lights on Floating Aids to Navigation was approved for submission to EEP11 for final review and approval.

Character recognition of cardinal buoys

Workshop presentations clearly indicated that character recognition of cardinal buoys can become very ambiguous due to buoy motion. However, recognition of the colour of a light is unaffected by buoy motion. It was therefore considered that advantage be taken of modern technology with LED lanterns on cardinal buoys to use colour as the means of character recognition.

A proposal to amend the IALA Maritime Buoyage System for cardinal buoy lights was prepared initially for submission to EEP11. This submission, intended for the ANM Committee, included a proposal for revision of the IALA MBS w.r.t lights on cardinal buoys. These colour changes were outlined. The delegates recognised this as a major change.

It was accepted that the concept ought to be agreed upon first, before any details were decided upon. A delegate (practicing mariner) was critical of the concept, which was endorsed by another delegate (mariner). They stated that if the concept were to develop further, it would inevitably go to the ANM Committee, where a revision of the IALA maritime buoyage system was already underway. The Chair of ANM Committee's WG dealing with the MBS noted the idea and, without prejudice, did not 'dismiss it out of hand'. Another delegate said that there was potential for confusion between the proposal and some lateral / special marks.

O Eriksson noted that the opportunity to change the buoyage system came rarely and careful consideration ought to be given to changes that developments in colour light technology make

possible. It was agreed that the document ought to be submitted to the EEP Committee, noting the reservations raised.

It was proposed that the data in Section 4.2.1 of output document WG3-WP1 is valuable data and should be included in more general IALA documentation.

Guideline on Daymarks for Floating Aids to Navigation

WG3 used input document FA08-WG3-WP2 (Outline of Draft Guideline on Daymark Size and Focal Plane Height) as a basis to prepare a draft Guideline on Daymarks for Floating Aids to Navigation, taking account of other relevant input documents.

This had reached the stage of being a rough draft, which would take further EEP meetings (assessed document to be 60% complete, with at least two EEP meetings required) to complete. The concept for drawing up the guidelines was explained. The definition of a daymark was stated and agreed, although there was some discussion about the inclusion of size, leading to thoughts of range being a factor as to when certain aspects of a mark need to be identifiable. However, the definition, as stated, was accepted.

Gratitude was expressed to Germany for their input. Discussion of colour floatation ball, led to speculation of need to specify topmarks etc. Suggestion that the guidelines be passed to the ANM Committee before submission to Council, when considered suitably robust, was accepted.

The new guideline (WG3-WP3) was forwarded to EEP11 for further study and completion.

Report of WG4 – Plastic Buoys (Chairperson: Guy Cunty)

Twenty three delegates, including seven IALA Industrial Members, from seventeen different countries drew on their collective experiences with the management of floating aids to improve and update the content of the IALA Guidelines on Plastic Buoys, first produced in 1997.

Since that time, much of the information contained in the document has changed and therefore, it needs to be corrected and updated. It also needs to take into account the experiences reported by IALA members.

The constraints on the use of plastic materials in constructing large buoys are no longer relevant. Now, plastic materials are used to built not only small but very large buoys, either nearly all plastic or with a combination of steel, aluminum and plastics. There is today fifteen years of experience in the use of these buoys and the knowledge of the members of the group on GRP and polyethylene has made useful contributions in updating the document.

In plenary, the definition of a plastic buoy was presented. A suggestion that the words ‘floating hull’ would be better than the word ‘hull’ was not universally endorsed. It was agreed that the definition, as given, would be considered by the EEP Committee. G Cunty itemised the four current types of ‘plastic’ technology currently used for buoys, before outlining the structure and content of the guidelines (as developed, so far). Expertise at the workshop was mainly in GRP and PE, so further input on other types is required and the EEP Committee ought to arrange for this. It was agreed that the document be submitted to the EEP Committee.

END OF DAY

Day Four – Closing of the Workshop

Sessions 12 – Working Groups report to Plenary

O Eriksson outlined the programme for the remainder of the workshop and encouraged delegates to make the most of the remaining opportunity to see the exhibition.

Each of the Working Group Chairmen presented an overview of the work carried out by their groups (refer to their reports in the section titled Sessions 8 to 11 – Working Groups.

O Eriksson thanked the Chairmen and the working groups, remarking that all work would be furthered at the EEP Committee, to which there was general agreement.

Sessions 13 – Visit to the Brest Musee de la Marine

Delegates visited the Musee de la Marine in Brest from approximately 1100 hrs to 1300 hrs.

Session 14 – Conclusions and Recommendations of the Workshop

Facilitator – Mahesh Alimchandani, IALA

Conclusions

1. Quality control of mooring chains is essential.

2. The type of steel used in mooring chains needs careful evaluation. Low carbon open link chains can be a very cost effective choice; however, care must be taken to match such chains to the application. Different materials at mooring interface points must be compatible. A detailed material specification should be used to ensure consistent wear performance of chain and other mooring components.

3. Synthetic moorings can be highly beneficial, resulting in a saving of ship time and reducing impact on the environment in the thrash areas. Rubber cord moorings reduce mooring loads by up to half and also reduce the radius of a buoy's swinging circle. The servicing of synthetic moorings presents new challenges in the handling of moorings.

4. Computer software for mooring design exists, which enables mooring design by non-specialists. However, in order to enable existing models to be used world-wide, modifications are required so as to enable input of local parameters.

5. The development in plastic buoy technology has now reached a stage where they can meet most floating aids to navigation requirements

6. A case can be made to justify the advantages of deploying plastic buoys, as compared to steel buoys in similar situations. This is based on the reduced frequency of refurbishment and reduced spares inventory for plastic buoys.

7. Modern high-performance paint systems can be expected to last in excess of ten years. While fluorescent paint exhibits high visible range, its life is limited to 3-4 years.

8. The use of highly saturated fluorescent colours dramatically increases the recognition range of red and green surface colours (particularly green).

9. Buoy motion can seriously affect a user's ability to recognise its signal light characters.

10. In order to advance work on improving the probability of recognising the signal character of a floating aid, an agreed model for establishing the probability of positive recognition is required.

11. When designing signal light systems, cognisance must be taken of local conditions (such as visibility, conspicuity, sea state conditions, vertical divergence and buoy dynamic characteristics). Reliance must not be placed on nominal range as a sole predictor of operational range.

12. In order to distinguish day marks, an angle of at least three minutes of arc must be subtended at the observer's eye. In addition, sufficient luminance contrast or colour difference must exist.

13. Lateral marks with fluorescent colours have the highest recognition distance. Compared to RAL "traffic" colours, fluorescent colours are between 2- 9 times more effective than RAL "traffic" colours, whilst bright and saturated ordinary colours increase the recognition distance.

14. There is a trend to replace major floating aids (such as lightfloats and LANBYs) with buoys.

Recommendations

1. IALA should develop a product certification template for mooring chains. Work is in progress to develop this template.

2. IALA should review and update its guidance on floating aid moorings.

3. IALA should review and update its guidance on synthetic and rubber cord moorings for floating aids.

4. IALA should facilitate the development of computer software for mooring design, for use by IALA members.

5. IALA should review and update its guidance on plastic buoys.

6. Taking into account developments in high performance paint systems, IALA should review and update its guidance on painting of buoys and maintenance of buoys and small aids to navigation.

7. IALA should develop a model for establishing the probability of positive recognition of signal lights on floating aids.

8. IALA's ANM Committee should consider a proposal for the revision of lights characteristics on cardinal buoys.

9. IALA should develop guidance on vertical divergence and focal height of lights on floating aids to navigation.

10. IALA should develop guidance on day marks for floating aids to navigation.

11. IALA should consider revising its recommendation on surface colours in relation to 'traffic red and traffic green'.

12. IALA should liaise with international paints standard bodies to assign specifications for surface colours specifically for use on marine aids to navigation.

13. IALA should consider holding a workshop on floating aids and associated moorings in 4-5 years time.

Closing of the Workshop

Jean-Jacques Quinquis of CETMEF Brest, closed the workshop. He informed the delegates that the idea for such a workshop had been mooted eighteen months ago. He expressed his gratitude to the members of his staff for all their hard work in planning and organising the event. He then referred to the workshop's outputs and stated that he was pleased with the progress; this would enhance the standing of the IALA in the international community. After thanking the Workshop Steering Committee and IALA, he remarked that the delegates had been fortunate with the weather. He then wished those going on to EEP11 next week a productive meeting, those visiting Ushant Island a pleasant visit and those departing, a safe journey.

O Eriksson concluded with comments on how much work had been done and the impressive results that had flowed from it. He felt that the goals set by the Steering Committee had been achieved and was happy to report back to IALA that the outputs of the workshop should be accepted.

M Alimchandani said that the current draft report would be finalised fifteen days after the workshop. The finalised report would be e-mailed to all delegates.

Omar thanked CETMEF, the Steering Committee, the Secretariat and the WG Chairmen before adjourning the workshop.

A CD-ROM containing electronic copies of all presentations, draft guidance documents, photographs and the draft report (but without an up-to-date version of the conclusions and recommendations) was provided to each delegate.

Visit to VTS and MRCC

After the workshop, CETMEF arranged for delegates to visit Corsen VTS and MRCC.

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Annex 1: List of Output Documents

Documents for Finalisation by the EEP Committee

1. From WG1:

   Draft IALA Guideline on Floataid Moorings

2. From WG2:

   Draft IALA Guideline on the Maintenance of Buoys and Small Aids to Navigation Structures.

3. From WG3:

   - Draft IALA Guideline on Vertical Divergence and Focal Height of Lights on Floating Aids to Navigation.
   - Proposal for a revision of the IALA Maritime Buoyage System for cardinal buoy lights.
   - Draft IALA Guideline on Daymarks for Floating Aids To Navigation.

4. From WG4:

   Draft IALA Guideline on Plastic Buoys

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WG3 – Visual Aspects of Buoys

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3	DAM	Peter
4	DOYLE	Seamus
5	ERIKSSON	Omar
6	HAGMEYER	Jorg
7	KERGADALLAN	Xavier
8	KURIN	Sven
9	LEWIS	Roger
10	LINDBERG	Jonas
11	ROYAL PETERSEN	Jorgen
12	MOLNES	Jarl
13	OZANNAT	Michel
14	PLACIDO CONCEICAO	Victor
15	RAHMAN	Abdul
16	SANTOS	Manuel
17	ZHIJIANG	Shen

WG4 - Plastic Buoys

Chair – Guy Cunty

1	BARTKOWIAK	Dominik
2	COSSETTE	Georges
3	CUNTY	Guy
4	DA KAARSBERG	Schmidt
5	DELGADO ALVES	Marcelo
6	HOLTET	Rolf
7	JESION	Piotr
8	PROCTOR	Chris
9	LAGERWALL	Christian
10	MANSNER	Lars
11	O'HIGGINS	Kieran
12	OSYPCHUK	Sergiy
13	OXNARD	David
14	SHELUDKO	Oksana
15	SYMONENKO	Sergiy
16	VAN DER KUIL	Hans
17	YAXLEY	Mike
18	YOULIANG	Yang
19	FURUKAWA	Kiomi
20	CLARK-MAUDSLEY	Christine
21	MIELCAREK	Jean-Francois
22	HERMANSON	Bo
23	JORO	Risto

Annex 4: Social Events

1. On Monday, 31st March, 2008, the Mayor of Brest hosted a welcome reception at the Hotel de Ville (Town Hall) for the workshop delegates from 1800-1930 hrs. On behalf of the Mayor, Madame Abiven, the First Deputy, welcomed all delegates. Mahesh Alimchandani responded with thanks on behalf of IALA and the workshop delegates. An English translation of Madame Abiven's speech is given below.

2. On Wednesday, 02 April 2008, delegates boarded the catamaran *Azenor* at approximately 1945 hrs for a dinner cruise around Brest Harbour.

3. On Friday, 04 April 2008, delegates visited the Musee de la Marine in Brest from approximately 1100 hrs to 1300 hrs.

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Ladies and Gentlemen

It is a great pleasure for me to welcome you to Brest on the occasion of this international workshop, held under the auspices of the International Association of Marine Aids to Navigation and Lighthouse Authorities.

Our city witnesses a lot of scientific and technological activity. However, amongst the meetings and conferences that are held here regularly, those dedicated to the sea and the oceans hold prominent positions.

CETMEF is our partner in the great events that Brest, the "Ocean Metropolis", hosts. I refer to the annual meetings of Sea Tech Week and Safer Seas, annual meetings that gathered global players in safety and security at sea, and which were a great success last year.

Brest has well earned its title as the European capital of sea sciences and technologies.

The strengthening, since some years, of Brest's position in the international maritime community did not happened by chance. It is the result of the strong capacity of the local players to work together, and to the rich maritime history of the city.

We often hear that one never passes through Brest but comes to it because beyond, there is nothing but the Ocean. Brest is therefore rightly perceived to be both the end of, and the entrance to Europe. This is undoubtedly what Richelieu thought when he settled the Navy in Brest in 1631. No doubt, Kerguellen, Bougainville and La Pérouse thought the same when they departed to discover the world. This feeling has been strengthening steadily and almost everybody in Brest can now relate to this.

Many of those who come to live here, do so for the sea. Be they scientists, industrialists, soldiers, yachtsmen, tourists or sailors, they generate a unique synergy, and are the source for creativity and innovation. Marine safety applications and innovations in marine marking are good examples. Brest is also the first French port for ship repairs and is also the first city in France with a marina with 2,000 moorings, with 200 set aside for transiting craft.

This presence has undoubtedly shaped the nature of Brests' inhabitants. Here one can find a taste of adventure, discovery and an openness to the world and, certainly more than elsewhere, the need to join energies and goodwill.

Together we are constantly making all efforts to transmit this passion, either at Oceanopolis or at the next international sea event "Brest 2008". You will find here the sense of hospitality of a city open to the sea but which, at first, knows that it is ashore that the problems faced at sea are solved.

Welcome to all those who are perhaps coming here for the first time. I wish you an excellent workshop and hope that you will feel like coming back.

Thank you all.

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Annex 5: Workshop Programme

IALA Workshop on Developments in Floating Aids and Associated Moorings

1 - 4 April, 2008

Venue: Le Quartz, Centre De Congres
2 et 4, avenue Clemenceau
29210 Brest, France

Final Programme

Monday, 31st March, 2008

Time	*Event*	*Location*
1700 – 1800 hours	Workshop Steering Committee meeting	'IALA Office' @ Le Quartz
1800 – 1930 hours	Welcome Reception	Hosted by Mayor Location: Town Hall ('Hotel de Ville' on maps) Dress Code: Smart Casual

Day 1 – Tuesday, April 1st, 2008

Time	Activity	Presenter	Chair
0800 - 0900	**Registration / Tea and coffee available**		
0900 - 0945	**Session 1 – Opening of the Seminar** Welcome from hosts – CETMEF Response by IALA and Administrative details, programme outline, workshop expectations Health and safety brief ***Delegates gather for workshop photograph prior to the coffee break***	 Mr J Manchard (DAM) and G Caude, Director CETMEF Mahesh Alimchandani, Technical Coordination Manager, IALA (CETMEF / Le Quartz staff)	**CETMEF to open workshop**
0945-1015	**Refreshment Break – *Industrial Members Exhibition opens***		
1015-1200 (105 min session)	**Session 2 – Moorings**		**Omar Eriksson, Denmark**
5 min	Introduction – methods of extending life of moorings	Adrian Wilkins, UK	
15 min	Mooring designs, including loads (include rubber moorings)	Sipke Hoekstra , The Netherlands	
15 min	MOORSEL program in US	Wayne Danzik, US	
10 min	Synthetic moorings	Peter Devies and Nicolas Auger French Institute of Marine Science & CETMEF	
30 min	Ring Sinkers Developed by SMA and different mooring methods and materials being tested by SMA	Sven Kurin and Capt Anders Gelbort, Sweden	
10 min	Inspection of mooring chains	Wayne Danzik , US	
15min	Conventional Chain Moorings	Guy Marit (of Marit, France)	
	Questions on session (Q's to be referred to WGs)		
1200 - 1300	**Lunch - *Industrial Members Exhibition open***		
1300-1445 (105 min session)	**Session 3 – Floating Aids - Structural issues**		**Adrian Wilkins, UK**
15 min	France – experience with plastic buoys	Guy Cunty, CETMEF	
15 min	Marine growth on buoys – case history	Wayne Danzik, US	

Time	***Activity***	***Presenter***	***Chair***
15 min	Plastic Material - focus on life span	Mobilis	
10 min	Buoy – Paint protection - A coating system for the future	Ron Blakeley, Trinity House, UK	
10 min	Experimental Coatings for Aids to Navigation	Colin Bower, Maker Coatings	
10 min	Plastic buoys	Sipke Hoekstra, The Netherlands	
15 min	Plastic Buoys in Ice	Lars Mansner, Sabik, Finland	
10 min	Overview – experience with plastic buoys in Australia	Dave Jeffkins, AMSA, Australia	
10 min	Cost comparison of buoys – steel v/s plastic	Christine Clark, Tideland UK	
	Questions on session (Q's to be referred to WGs)		
1445-1515	**Refreshment Break - *Industrial Members Exhibition open***		

Time	***Activity***	***Presenter***	***Chair***
1515-1700 (105 minute session)	**Session 4 – Floating Aids - Visual issues**		
30 minutes	Buoy stability, vertical divergence and character recognition of a floating aid to navigation	Omar Eriksson, Denmark and Roger Lewis, UK	Seamus Doyle, Ireland
5 min	Basic rules for calculating static buoy stability	Adrian Wilkins, UK	
20 min	Buoy daymarks - size and colour	Sabina Schollmeier, Germany	
20 min	Radar reflectors on spar buoys	Risto Joro, Finland	
20 min	AIS on floating aids – practical aspects	M Card, Zeni Lite Co. Ltd, Japan	
END of DAY	Overview of work to be done on IALA guidance documents	**Adrian Wilkins**	

27 Mar: CANCELLED – DUE TO SHIP BEING CALLED AWAY ON DUTY

~~**1845 hrs: Bus transport available at workshop venue**~~

~~**1900 hrs: Reception on board THV Galatea *(Invitations will be distributed)***~~

~~**2030 hrs: Bus transport available for return trip**~~

Day 2 – Wednesday, April 2nd 2008

Time	***Activity***		***Chair***
0830 - 0900	**Coffee / Tea on arrival**		
0900-1300	**Session 5 – Technical Visit to Quayside, hosted by French Lt Ho Authority** ***Covered area (8m by 5m) available for delegates, in case of rain*** ***0900: Bus transport available*** *(but a 20 minute walk from workshop venue)* **THREE ASPECTS TO THE VISIT** **1. Buoys on display:** **a. from French Service** ***Two new, three old*** **b. Plastic Buoys from The Netherlands.** **c. from Industrial Members** • **(GISMAN x 3)** • **Floatex (one buoy, placed on quayside)** **2. Demonstration by France of hot-welding repair technique for polyethylene.** **3. Visit buoy tenders** **1. Armorique (France)** ~~**2. Galatea (UK)**~~ **3. Frans Naerebout (The Netherlands)** ***1245 hrs : Bus transport available for trip back to workshop venue***		

1300-1400	**Lunch - *Industrial Members Exhibition open***		
1400 – 1530	**Session 6** – **Brief Plenary** **Working Groups commence** Four Working Groups in session		
1530 – 1600	**Break - *Industrial Members Exhibition open***		
1600-1730	**Session 7** – **Working Groups** Four Working Groups in session		
1730	End of day		

1730-1900 POSSIBLITY TO VIEW QUAY SIDE EXHIBITION (Buoys Only)

Evening event – Workshop Dinner
Dress Code – Smart Casual

1900 hrs	Assemble at workshop venue. Bus transport available to the harbour (boarding point is near the quayside exhibition)
1930 hrs	Arrive at quay to board vessel *Adenor* for Workshop Dinner
	Buoy display by day and night (CETMEF staff to provide information)
2300 hrs	Return to wharf. Transport back to workshop venue

WORKING GROUP ARRANGEMENTS

(Paper and electronic copies provided for all participants)

1. **WG 1 – Moorings (Chairman: Adrian Wilkins)**

   Update and combine the Practical Notes on the Use of Mooring Chains for Floating Aids to Navigation (1989) with IALA Guidelines on Synthetic Mooring Lines (1024) and relevant content from IALA Recommendation on the design of normal moorings (E 107). *Update E 107 accordingly*. Also, develop new IALA Guideline on Floating Aid Moorings (draft developed by A Wilkins).

2. **WG2 - Buoy Maintenance (Chairman: Wayne Danzik)**

   Update IALA Guideline for Painting Aids to Navigation Buoys (1015) and update IALA Guideline on the Maintenance of Buoys and Small Aids to Navigation Structures (1040) – *these two can be merged into one.*

3. **WG3 – Visual Aspects of Buoys (Chairman: Seamus Doyle)**

   Develop new IALA Guideline on Vertical Divergence and Focal Height of Lights on Floating Aids to Navigation *(draft provided)*
   Develop IALA Guideline on Daymark Size and Focal Plane Height for Floating Aids to Navigation *(outline developed).*
   Reference documents on surface colours and performance on marine radar reflectors are provided

4. **WG4 – Plastic Buoys (Chairman: Guy Cunty)**
   Update IALA Guideline on Plastic Buoys (1006)

FILE SERVER

The files are available at the IALA File Transfer Protocol (FTP) Server

To access them, please enter the following in the address bar of your web browser

ftp://193.251.3.91

User name ftpuser

Password siren

Day 3 – Thursday, 3rd April, 2008

Time	*Activity*		*Chair*
0830 - 0900	**Coffee / Tea on arrival**		
0900-1030	**Session 8** – **Working Groups** Four Working Groups in session		
1030-1100	**Break - *Industrial Members Exhibition open***		
1100-1300	**Session 9** – **Working Groups** Four Working Groups in session		
1300-1400	**Lunch - *Industrial Members Exhibition open*** Working Group Chairs and Vice Chairs to meet with Steering Committee to confirm output.		
1400 – 1530	**Session 10** –**Working Groups** Four Working Groups in session		
1530 – 1600	**Break - *Industrial Members Exhibition open***		
1600-1730	**Session 11** – **Working Groups** Four Working Groups in session		
1730	End of day		

1730-1900 POSSIBLITY TO VIEW QUAY SIDE EXHIBITION (buoys only)

FREE EVENING

Day 4 – Friday, April 4th , 2008

Time	*Activity*	*Group Number / Topic*	*Location / Chair*
0830 - 0900	Tea / coffee on arrival		Omar Eriksson, Denmark
0900 – 1030	Session 12 – **Working Groups to report outcomes to Plenary**		Representatives from Working Groups
1030 – 1100	**Coffee**		
1100 – 1400	**Session 13** Visit maritime museum. 10 minutes away by bus. Bus departs workshop venue at 1100 hrs, and museum at 1245 hrs		
1300-1400	**Lunch break**		
1400 – 1530	Session 14 **Review of Draft Conclusions and recommendations.** Available: • Paper version of draft report • Paper version of Conclusion and Recommendations of workshop Output documents, presentations and report provided on CD ROM **CLOSING OF WORKSHOP**		IALA

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SAT, 5th April, 2008 – SIGHT SEEING

A day long sight-seeing trip to Ushant Island, including a visit to the French lighthouse museum, has been organized on Sat/5th April by CETMEF / DAM.

All delegates and their accompanying partners are invited to join. There is no charge for the trip.

Persons interested in joining are requested to CONTACT CETMEF / DAM STAFF and assemble at the workshop venue at 0745 hrs. Return to Brest will be at approximately 1900 hrs.

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