IHO Standards for Hydrographic Surveys (S-44)

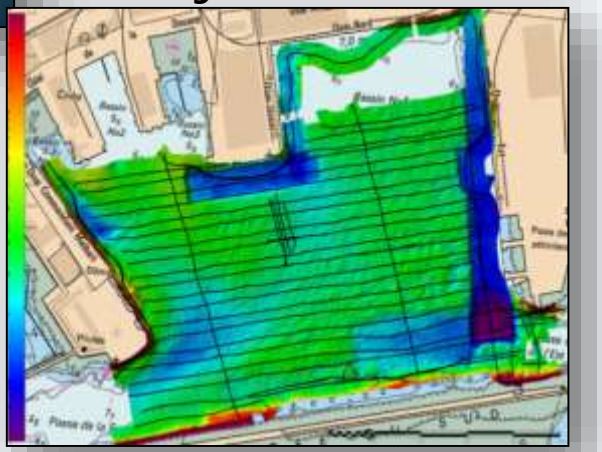
Changing Technologies, Changing Data Uses, Changing Specifications

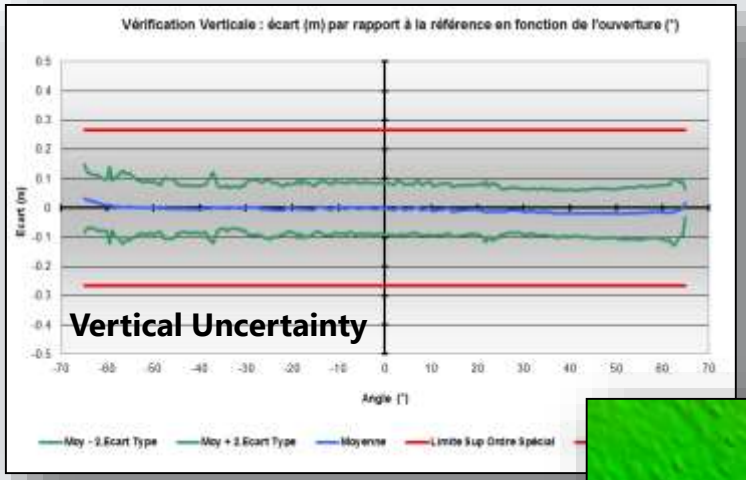
Simon Ironside
Chair FIG Commission 4, Working Group 4.1
Standards and Guidelines for Hydrography

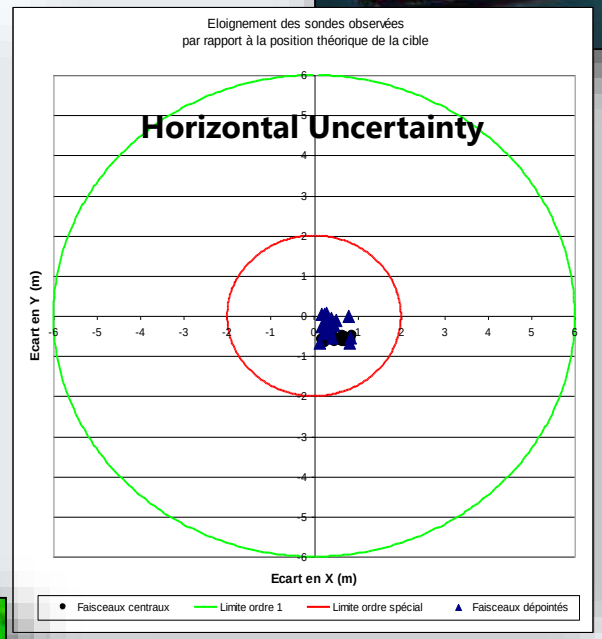
IHO Standards for Hydrographic Surveys (S-44)

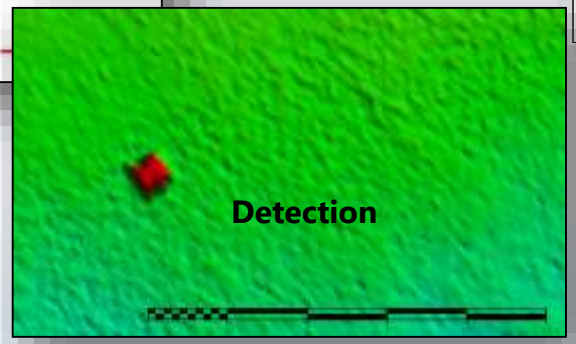
S-44 provides minimum standards for hydrographic surveys dedicated to safety of navigation

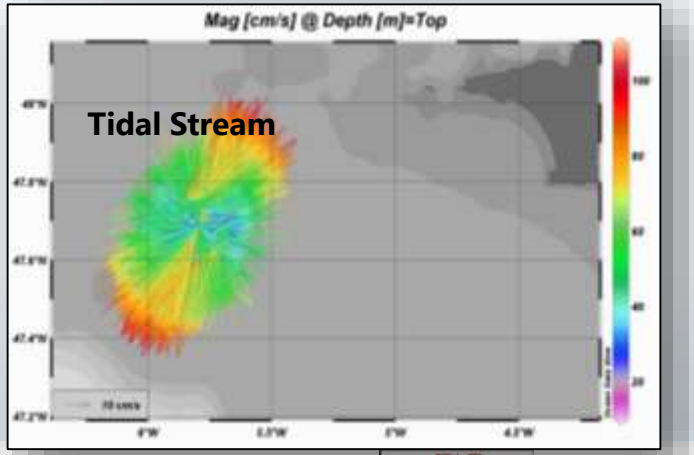
Coverage
Positioning of Aids to Navigation, of Coastline









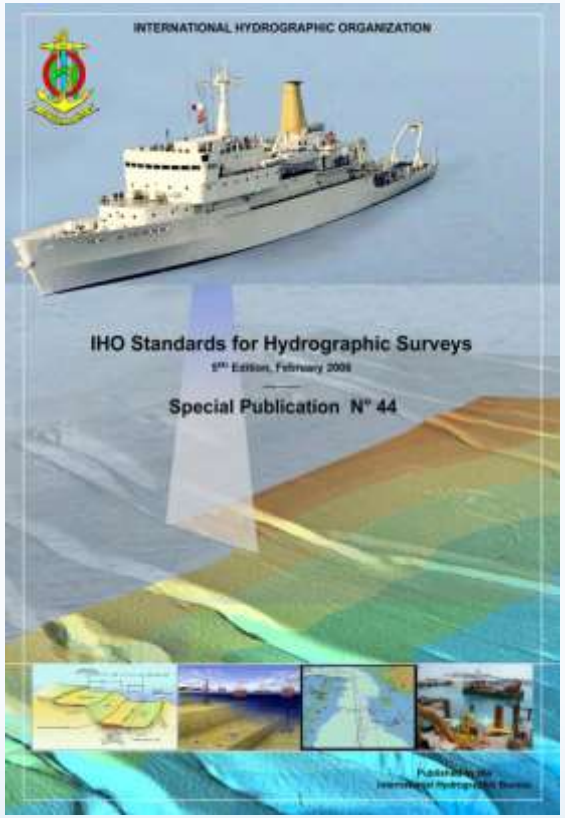


IHO Standards for Hydrographic Surveys (S-44)

Introduction

S-44 is the International Hydrographic Organization's **minimum** standard … *'for the execution of hydrographic surveys for the collection of data … used to compile navigational charts … for the safety of surface navigation and the protection of the marine environment'*

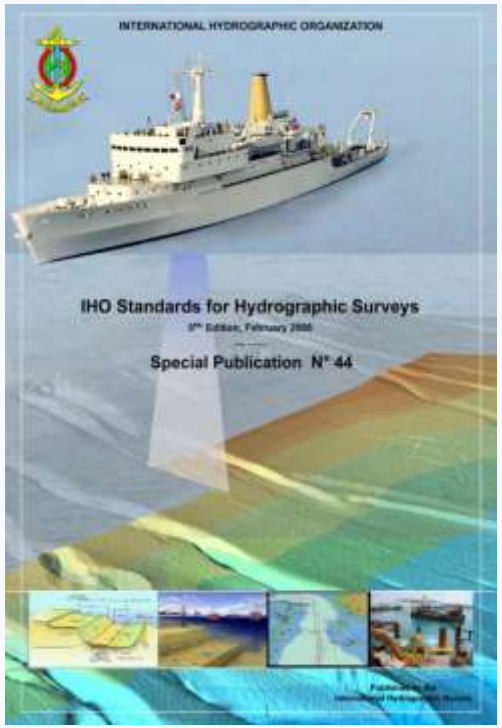
Introduction to S-44, 5th Edition February 2008



IHO Standards for Hydrographic Surveys (S-44)

Introduction

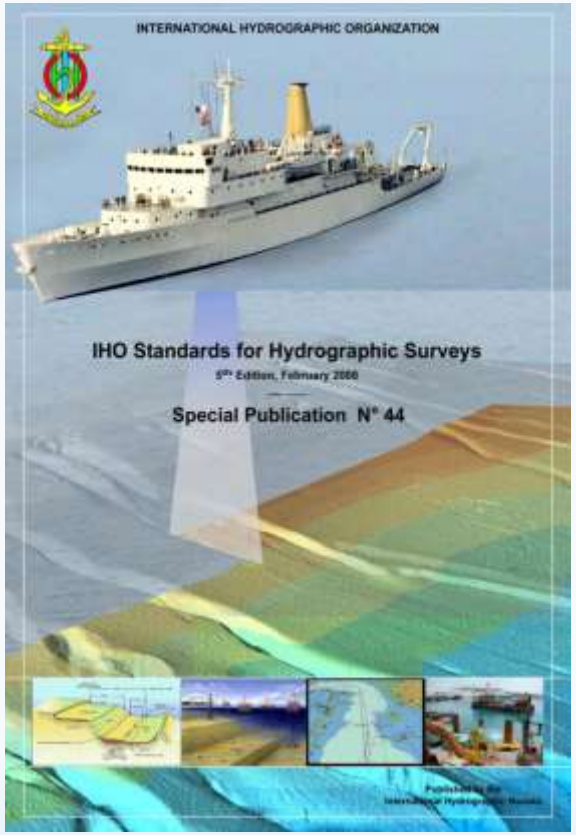
S-44 is a standard, NOT a specification. It is used either directly by IHO member state organisations or as the basis of national nautical charting specifications i.e. LINZ HYSPEC, NOAA Hydrographic Survey Specifications and Deliverables, FSIS44 (Finnish & Swedish implementation of S-44) etc.



IHO Standards for Hydrographic Surveys (S-44)

Introduction

S-44 is not mandatory for non-governmental organisations (i.e. ports and harbour authorities) even if conducting navigational/UKC surveys



IHO Standards for Hydrographic Surveys (S-44)

Background

1st Edition of S-44 published in 1968.

4th Edition (1998) introduced four orders of survey to cover different areas:

Special – critical areas with minimum UKC

1 - ports/harbours and approaches

2 – coastal areas with depths < 200m

3 – depths > 200m and not covered by higher orders of survey

IHO Standards for Hydrographic Surveys (S-44)

Background

5th Edition (2008) divided Order 1 into 1a and 1b and removed Order 3

Order 1a is essentially the same as 4th Edition Order 1, but requires that surveys locate all targets within the survey area

Order 1b retains the same vertical and horizontal accuracies but removes the need to detect small objects

IHO Standards for Hydrographic Surveys (S-44)

S-44 5th Edition Classification of Surveys

- Special Order – UKC critical, full seafloor search, depth < 40m
- Order 1a – UKC less critical, full seafloor search but size of features to be detected larger than Special Order, depth 40 – 100m
- Order 1b – UKC non-critical, full seafloor search not required (although permitted line spacing of 3 x average depth limits the size of the feature likely to remain undetected), depth 40 – 100m
- Order 2 – Full sea floor search not required – general seafloor description adequate, line spacing 4 x average depth, depth > 100m

IHO Standards for Hydrographic Surveys (S-44)

Background

5th Edition explicitly requires the overall survey system (not just the echo sounder component) to be capable of meeting the Minimum Standards for Hydrographic Surveys laid out in Table 1

IHO Standards for Hydrographic Surveys (S-44)

S-44 Review

In March 2017 IHO established a Project Team on Hydrographic Surveys (HSPT) under the Hydrographic Services and Standards Committee (HSSC) to review S-44.

FIG Commission 4 (Working Group 4.1) has Observer status on the HSPT and is actively involved in the review process.

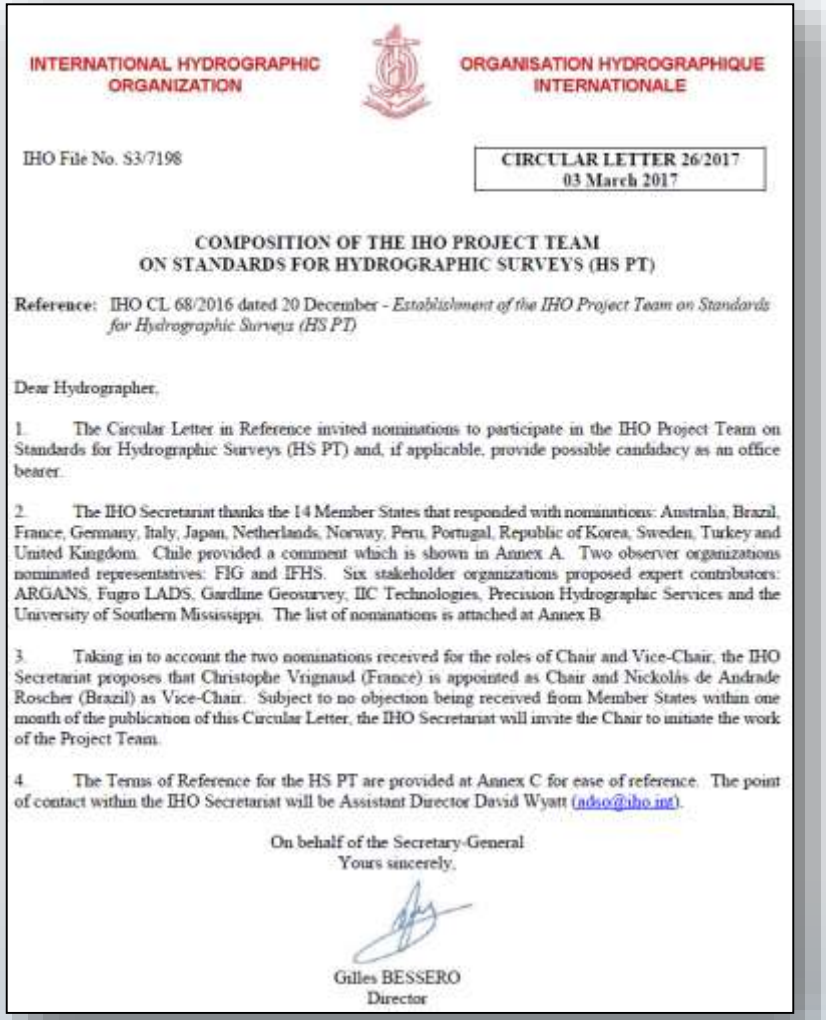
IHO Standards for Hydrographic Surveys (S-44)

Terms of Reference – IHO Circular 26/2017

I. Review existing S-44, identify deficiencies

II. Following review update content and structure and publish 6th Edition

III. On completion advise HSSC whether the HSPT continues as a working group or disbands



INTERNATIONAL HYDROGRAPHIC ORGANIZATION

ORGANISATION HYDROGRAPHIQUE INTERNATIONALE

IHO File No. S3/7198

CIRCULAR LETTER 26/2017
03 March 2017

COMPOSITION OF THE IHO PROJECT TEAM ON STANDARDS FOR HYDROGRAPHIC SURVEYS (HS PT)

Reference: IHO CL 68/2016 dated 20 December - *Establishment of the IHO Project Team on Standards for Hydrographic Surveys (HS PT)*

Dear Hydrographer,

1. The Circular Letter in Reference invited nominations to participate in the IHO Project Team on Standards for Hydrographic Surveys (HS PT) and, if applicable, provide possible candidacy as an office bearer.

2. The IHO Secretariat thanks the 14 Member States that responded with nominations: Australia, Brazil, France, Germany, Italy, Japan, Netherlands, Norway, Peru, Portugal, Republic of Korea, Sweden, Turkey and United Kingdom. Chile provided a comment which is shown in Annex A. Two observer organizations nominated representatives: FIG and IFHS. Six stakeholder organizations proposed expert contributors: ARGANS, Fugro LADS, Gardline Geosurvey, IIC Technologies, Precision Hydrographic Services and the University of Southern Mississippi. The list of nominations is attached at Annex B.

3. Taking in to account the two nominations received for the roles of Chair and Vice-Chair, the IHO Secretariat proposes that Christophe Vrignaud (France) is appointed as Chair and Nickolás de Andrade Roscher (Brazil) as Vice-Chair. Subject to no objection being received from Member States within one month of the publication of this Circular Letter, the IHO Secretariat will invite the Chair to initiate the work of the Project Team.

4. The Terms of Reference for the HS PT are provided at Annex C for ease of reference. The point of contact within the IHO Secretariat will be Assistant Director David Wyatt (adso@iho.int).

On behalf of the Secretary-General
Yours sincerely,

Gilles BESSERO
Director

IHO Standards for Hydrographic Surveys (S-44)

Hydrographic Surveys Project Team (HSPT)

Chair - Christophe Vrignaud (FRA)
Vice Chair - Nickolas Roscher (BRA)
Secretary - David Wyatt (IHO)
44 Members - 16 Member States, Observers (including FIG), Expert Contributors and IHO

HSPT1 Principal Activities/Achievements

"Kick off" meeting in PARIS, 20-22 June 2017
(28 representatives - 13 Member States, Observers, Expert Contributors and IHO).

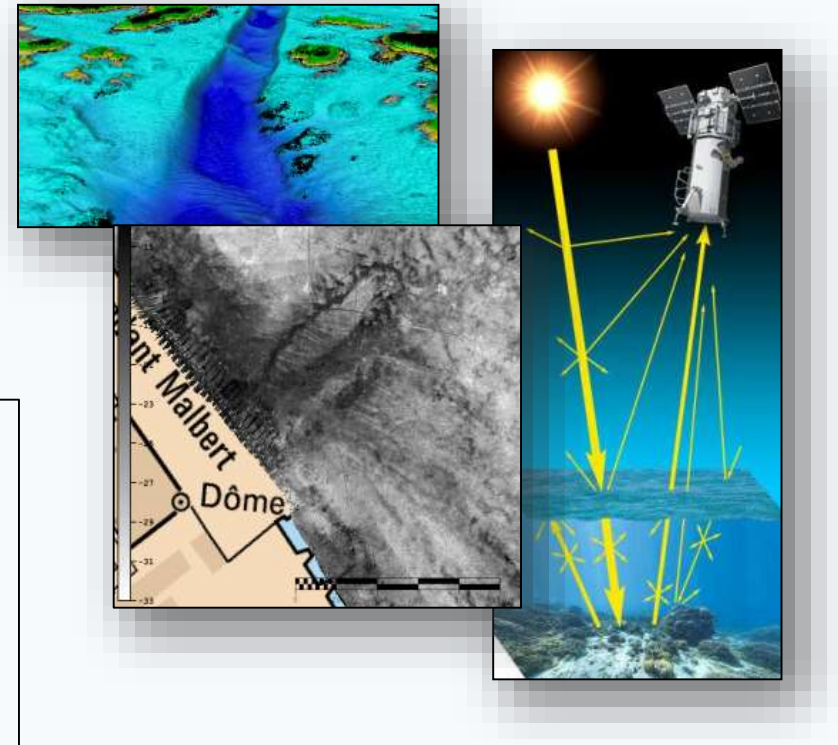
1st meeting of HSSC Project Team on Standards for Hydrographic Surveys (HSPT1) at Palais de la Porte Dorée, Paris, France, 20th to 22th June 2017

Three outcomes:

1. Identification of S-44 limitations
2. Questionnaire
3. S-44 "Table 1" possible evolutions

HSPT1 Principal Activities/Achievements

S-44 Considerations



Surveyors face increasingly more efficient technologies (coverage, accuracy, new features).

Does the S-44 need to be more constrained or more flexible in order to accommodate data that might be less accurate but remain priceless when information is missing?

HSPT1 Principal Activities/Achievements

S-44 Considerations

Bathymetric surveys for public maritime policies are sometimes undertaken by untrained people, or, using inappropriate hydrography specifications.

Knowledge of hydrographic surveys standards is very important not only for the hydrographic community, but also for private/public contracting bodies.
(see the “European Coastal Mapping” project conclusions)

EMODnet
European Marine Observation and Data Network

HSPT1 Principal Activities/Achievements

S-44 Considerations

"Hydrographic Needs" extend beyond safety of navigation (see "Blue Economy")

Does the S-44 have to deal exclusively with safety of navigation or take into account other hydrographic needs?

HSPT1 Principal Activities/Achievements

S-44 Limitations – 10 identified:

1 - S-44 only focused on the nautical chart and an associated depth classification (possible solution: matrix or updated table)

2 – Difficult to overview all requirements (possible solution: matrix or updated table)

3 - Limited number of definitions (possible solution: support and liaison with the DQWG and VIM3)

4 - Misalignment between S-44 and CATZOC (possible solution: contacts with S-101WG and DQWG)

5 - Grid resolution and bathymetric surfaces not addressed (contact with S-102WG)

6 - Confusion between a-priori TPU and a-posteriori Qualification (review specific chapters of the S-44)

7 - S-44 should remain technological neutral (review specific S-44 chapters)

8 - Confusion of metadata attributes

9 - Outdated chapters

10 - Annexes A & B to be placed in C-13 - Manual on Hydrography?

AUS + GER : Coordinating Editors (compiling all proposals/solutions from members for the 6th Ed. draft)

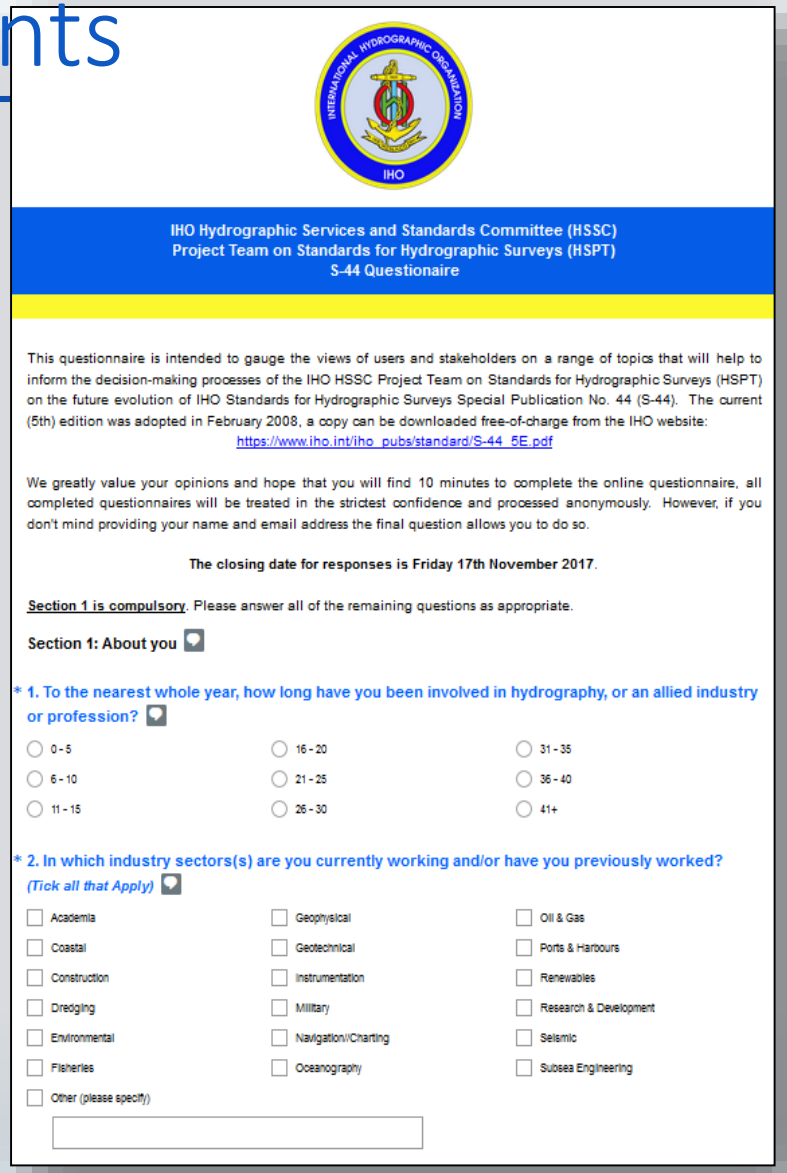
HSPT1 Principal Activities/Achievements

Questionnaire (https://www.surveymonkey.co.uk/r/HSPT_S-44_Q)

Views of S-44 users gauged including practitioners, stakeholders and the wider hydrographic community on a range of topics

Disseminated by IFHS, IHO, FIG and HSPT members. Closed Thursday 30th November 2017

500 replies received (61% involved in Navigation and Charting sector). Analysis by FIG, IFHS and Chair now complete and will directly inform 6th Edition discussions at HSPT2 meeting in Brazil in June.



IHO Hydrographic Services and Standards Committee (HSSC)
Project Team on Standards for Hydrographic Surveys (HSPT)
S-44 Questionaire

This questionnaire is intended to gauge the views of users and stakeholders on a range of topics that will help to inform the decision-making processes of the IHO HSSC Project Team on Standards for Hydrographic Surveys (HSPT) on the future evolution of IHO Standards for Hydrographic Surveys Special Publication No. 44 (S-44). The current (5th) edition was adopted in February 2008, a copy can be downloaded free-of-charge from the IHO website:
https://www.iho.int/iho_pubs/standard/S-44_5E.pdf

We greatly value your opinions and hope that you will find 10 minutes to complete the online questionnaire, all completed questionnaires will be treated in the strictest confidence and processed anonymously. However, if you don't mind providing your name and email address the final question allows you to do so.

The closing date for responses is Friday 17th November 2017.

Section 1 is compulsory. Please answer all of the remaining questions as appropriate.

Section 1: About you

* 1. To the nearest whole year, how long have you been involved in hydrography, or an allied industry or profession?

0 - 5 | 16 - 20 | 31 - 35
6 - 10 | 21 - 25 | 36 - 40
11 - 15 | 26 - 30 | 41+

* 2. In which industry sectors(s) are you currently working and/or have you previously worked? *(Tick all that Apply)*

Academia | Geophysical | Oil & Gas
Coastal | Geotechnical | Ports & Harbours
Construction | Instrumentation | Renewables
Dredging | Military | Research & Development
Environmental | Navigation/Charting | Seismic
Fisheries | Oceanography | Subsea Engineering
Other (please specify)

IHO Standards for Hydrographic Surveys (S-44)

IHO STANDARDS FOR HYDROGRAPHIC SURVEYS (S-44)
5th Edition February 2008

TABLE 1
Minimum Standards for Hydrographic Surveys
(*To be read in conjunction with the full text set out in this document.*)

Reference	Order	Special	1a	1b	2
Chapter 1	**Description of areas.**	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but *features* of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Chapter 2	**Maximum allowable THU 95% *Confidence level***	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Para 3.2 and note 1	**Maximum allowable TVU 95% *Confidence level***	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013	a = 1.0 metre b = 0.023
Glossary and note 2	***Full Sea floor Search***	Required	Required	Not required	Not required
Para 2.1 Para 3.4 Para 3.5 and note 3	***Feature Detection***	Cubic *features* > 1 metre	Cubic *features* > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres	Not Applicable	Not Applicable
Para 3.6 and note 4	**Recommended maximum Line Spacing**	Not defined as *full sea floor search* is required	Not defined as *full sea floor search* is required	3 x average depth or 25 metres, whichever is greater For bathymetric lidar a spot spacing of 5 x 5 metres	4 x average depth
Chapter 2 and note 5	**Positioning of fixed aids to navigation and topography significant to navigation. (95% *Confidence level*)**	2 metres	2 metres	2 metres	5 metres
Chapter 2 and note 5	**Positioning of the Coastline and topography less significant to navigation (95% *Confidence level*)**	10 metres	20 metres	20 metres	20 metres
Chapter 2 and note 5	**Mean position of floating aids to navigation (95% *Confidence level*)**	10 metres	10 metres	10 metres	20 metres

HSPT1 Principal Activities/Achievements

Table 1 Possible Evolution

Three options agreed to be investigated

Option A	Table 1 with only slight modifications
Option B	Option A + Matrix approach
Option C	Option B + Recommendations

Task lead by PRT/CAN/BRA

HSPT1 Principal Activities/Achievements

Table 1 with slight modifications

Only slight changes (such as including current measurements, seabed classification, and why not « grid/point cloud » considerations?)

Criteria	Special	1a	1b	2
Description	UKC critical	Areas <100m UKC required	Areas <100m UKC not required	Areas >100m
Total Horizontal Uncertainty (m)	2.0	5+5% depth	5+5% depth	20+10% depth
Total Vertical Uncertainty (m)	a = 0.25 b=0.0075	a = 0.5 b=0.013	a = 0.5 b=0.013	a = 1.0 b=0.023
Feature Detection (m^3)	1.0	2 or 10% Depth after 40m depth	NA	NA
Seafloor Coverage / Line Spacing	100%	100%	3 x average depth or 25 meters	4 x average depth
Positioning of Fixed Aids (m)	2	2	2	5
Positioning of Coastline & Topography (m)	10	20	20	20
Floating Navigation Aids (m)	10	10	10	20

HSPT1 Principal Activities/Achievements

Matrix Approach

Allows other "Hydrographic Needs" (more strict or flexible) to be considered with an extended list of criteria

→ S-44 could therefore propose **Recommendations** for other (non SON) types of surveys

	UKC (Exclusive Order)	Marine Renewable Energy	Oceanic	Engineering (Dredging?)	Engineering 2 (Cables, Pipes?)	Others.
Description	High-accuracy -dredge, build, UKC critical	Surveys dedicated for MRE farm	Oceanic soundings	High vertical accuracy	High Horizontal accuracy and detection capability	
Total Horizontal Uncertainty (m)	1	?	?	?	?	
Total Vertical Uncertainty (m)	a = 0.15 b=0.0075	?	?	?	?	
Feature Detection (m^3)	0.5	?	?	?	?	
Sea Floor Coverage / Line Spacing	200%	?	?	?	?	
Positioning of Fixed Aids (m)	1	?	NA	?	?	
Positioning of Coastline & Topography (m)	5	?	NA	?	?	
Floating Navigation Aids (m)	10	?	NA	?	?	
Final Survey Data Grid Resolution(m^2)	0.5	?	?	?	?	
Grid Source Sounding Density (pts/bin)	10	?	?	?	?	
Current Measurement	?	?	?	?	?	
Seafloor characterization	?	?	?	?	?	

HSPT1 Principal Activities/Achievements

Matrix *(prototype)*

Grey cells used for S-44 Orders (5th edition)

(backward compatibility)

		A	B	C	D	E	F	G	H	I	J	K
1	Total Horizontal Uncertainty (m)	?	?	?	?	2.0	?	?	?	?	5+5% depth	20+10% depth
2	Total Vertical Uncertainty (m)	?	a = 0.15 b=0.0075	a = 0.25 b=0.0075	a = 0.5 b=0.013	a = 1.0 b=0.013	a = 1.0 b=0.023	?	?	?	?	
3	Feature Detection (m^3)	?	0.25	?	1.0	2.0	?	?	?	10% depth beyond 40m	?	Not Required
4	Seafloor Coverage / Line Spacing	?	?	100%	?	?	?	?	3 x average depth or 25 meters	4 x average depth	?	Not Required
5	Positioning of Fixed Aids (m)	?	?	?	?	?	2.0	?	5.0	?	?	Not Required
6	Positioning of Coastline & Topography (m)	?	?	?	?	10.0	?	20.0	?	?	?	Not Required
7	Floating Navigation Aids (m)	?	?	?	10.0	?	20.0	?	?	?	?	Not Required
8	Structure Heights (m)	?	?	?	?	?	?	?	?	?	?	Not Required
9	Point Cloud Grid Res. (m)	?	?	?	?	?	?	?	?	?	?	
10	Point Cloud Density (pts/cell)	?	?	?	?	?	?	?	?	?	'	
11	Current (speed/direction)		0.1knot / 10°									Not Required
12	Seafloor characterization	Mandatory										Not Required

HSPT1 Principal Activities/Achievements

Matrix *(prototype)*

Yellow cells used for S-44 Order 1a

		A	B	C	D	E	F	G	H	I	J	K
1	Total Horizontal Uncertainty (m)	?	?	?	?	2.0	?	?	?	?	5+5% depth	20+10% depth
2	Total Vertical Uncertainty (m)	?	?	a = 0.25 b=0.0075	a = 0.5 b=0.013	a = 1.0 b=0.013	a = 1.0 b=0.023	?	?	?	?	
3	Feature Detection (m^3)	?	?	?	1.0	2.0	?	?	?	10% depth beyond 40m	?	Not Required
4	Seafloor Coverage / Line Spacing	?	?	100%	?	?	?	?	3 x average depth or 25 meters	4 x average depth	?	Not Required
5	Positioning of Fixed Aids (m)	?	?	?	?	?	2.0	?	5.0	?	?	Not Required
6	Positioning of Coastline & Topography (m)	?	?	?	?	10.0	15.0	20.0	?	?	?	Not Required
7	Floating Navigation Aids (m)	?	?	?	10.0	?	20.0	?	?	?	?	Not Required
8	Structure Heights (m)	?	?	?	?	?	?	?	?	?	?	Not Required
9	Point Cloud Grid Res. (m)	?	?	?	?	?	?	?	?	?	?	
10	Point Cloud Density (pts/cell)	?	?	?	?	?	?	?	?	?	'	
11	Current (speed/direction)		0.1knot / 10°									Not Required
12	Seafloor characterization	Mandatory										Not Required

HSPT1 Principal Activities/Achievements

Table Evolution

The table can be now filled using known specifications but with a code, in accordance with the matrix.

Backward compatibility is available and other needs can be considered

Criteria	Special	1a	1b	2
Description	UKC critical	Areas <100m UKC required	Areas <100m UKC not required	Areas >100m
Total Horizontal Uncertainty (m)	2.0 1E	5+5% depth 1J	5+5% depth 1J	20+10% depth 1K
Total Vertical Uncertainty (m)	a = 0.25 b=0.0075 2C	a = 0.5 b=0.013 2D	a = 0.5 b=0.013 2D	a = 1.0 b=0.023 2F
Feature Detection (m^3)	1.0 3D	2 (3E) or 10% Depth (3I) after 40m depth	NA	NA
Seafloor Coverage / Line Spacing	100% 4C	100% 4C	3 x average depth or 25 meters 4H	4 x average depth 4I
Positioning of Fixed Aids (m)	2 5F	2 5F	2 5F	5 5H
Positioning of Coastline & Topography (m)	10 6E	20 6G	20 6G	20 6G
Floating Navigation Aids (m)	10 7D	10 7D	10 7D	20 7F

Outstanding Issues

- The matrix approach maintains the core philosophy of S-44 concept, but allows expansion and future growth.
- S-44 review ToR directs HSPT to focus on support of safety of navigation data products and services… whereas HSSC objectives are … *"to promote and coordinate the development of standards, specifications and guidelines for official products and services to meet the requirements of mariners and other users of hydrographic information".*
- Where is the line between the two?

Outstanding Issues

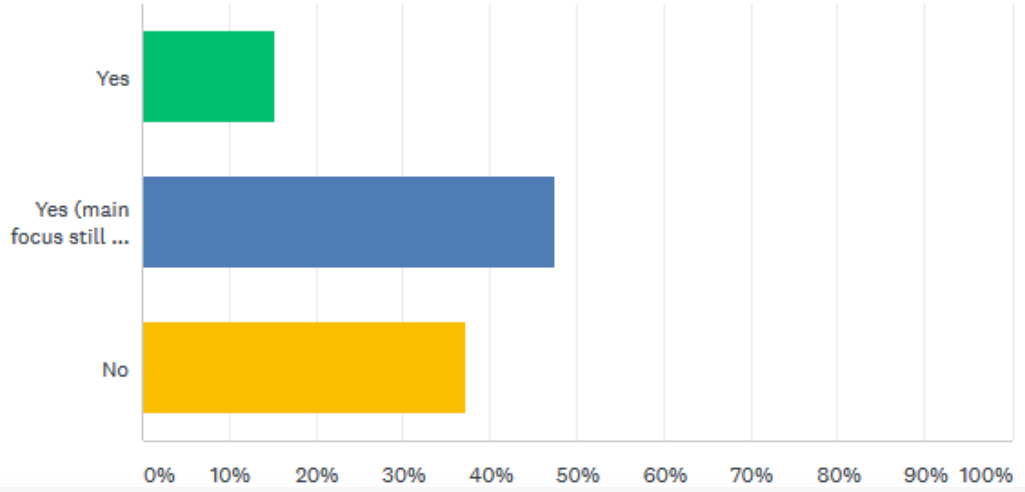
- Does the “Matrix approach” meet the expectations of the HSSC?

		A	B	C	D	E	F	G	H	I	J	K
1	Total Horizontal Uncertainty (m)											
2	Total Vertical Uncertainty (m)											
3	Feature Detection (m²)		0.25									
4	Seafloor Coverage / Line Spacing			100%								Not Required
5	Positioning of Fixed Aids (m)											Not Required
6	Positioning of Coastline & Topography (m)											Not Required
7	Floating Navigation Aids (m)											Not Required
8	Structure Heights (m)											Not Required
9	Point Cloud Grid Res. (m)											
10	Point Cloud Density (pts/cell)											
11	Current (speed/direction)		0.1knot / 10°									Not Required
12	Seafloor characterization	Mandatory										Not Required

Q25

Do you consider that S-44 should be extended for other purposes other than for the Safety of Navigation?

Réponses obtenues : 158 Question(s) ignorée(s) : 94



CHOIX DE RÉPONSES	RÉPONSES
Yes	15.19%
Yes (main focus still on safety of Navigation)	47.47%
No	37.34%

63% = Yes

HSPT Work Programme

- Development of Table/Matrix prototypes (BRA, PRT, CAN) - ongoing
- End November 2017: closing date for the Questionnaire - completed
- Consolidation and analysis of Questionnaire responses (IFHS/FIG/Chair) - completed
- Intersessional work on S-44 limitations and solutions, including Table/Matrix (Coordinating Editors and all Members) - ongoing
- May 2018: report to HSSC-10 on the ongoing activities
- July 2018 : HSPT2 Second meeting (Niteroi, Brazil)
- 2019: draft of Sixth Edition to be submitted to HSSC and proposal for a HS**WG**, if required.

Welcome to Niteroi, Brazil HSPT2!