Activities of KHOA on creation of S-10X test data sets and S-100 sea trial

Submitted by:	Republic Of Korea (KHOA)
Executive Summary:	KHOA has been conducting a research project to cope with S-100 and support S-100/S-10X test bed project of IHO. This paper presents research activities on creation of S-10X test data sets and S-100 sea trial.
Related Documents:	TSM4-5.1B KHOA Test Bed
Related Projects:	S-100 Testbed Project

Introduction / Background

Korea Hydrographic and Oceanographic Agency (KHOA), Republic of Korea, has participated in the IHO S-100 Test Bed project since the HSSC5, which was held in Shanghai, China in 2013. KHOA's main tasks within the test bed project has been to support the development of S-100 Geospatial Information Registry, S-100 Feature Catalogue Builder and to develop the S-100 Simple Viewer, which provides a facility to review and evaluate Test Data Sets(TDS) from draft product specifications, for instance S-101, S-111, S-124 and S-412 etc.

Additionally, IHO technical working groups have been working on preparation of the next generation products and services based on the S-100 framework and have been providing feedback on their draft product specification.

In connection with the IHO S-100 Test Bed, KHOA started an S-100 research project for 2016 that created 6 types of S-10X TDS. On 27th of October, 2016, a sea trial was conducted in the Janghan/ Gunsan port, which is located at the south-west coast of Korea.

In order to contribute to the IHO technical developments on S-100, this paper introduces the S-10X TDS created by KHOA and the procedures used for the S-100 sea trial. Due to the short reporting period, the comprehensive results from the sea trial will be reported to the relevant Working Groups. However some of the more significant issues identified with the above mentioned S-100 sea trial are presented briefly in this paper.

Analysis / Discussion

The analysis and discussion in this paper will focus on the following parts:

1) Characteristics of the sea trial area
2) S-10X TDS: Condition of the S-10X Product Specifications used to create the TDS
3) Sea trial system
4) Sea trial execution and preliminary results

1) Characteristics of the Sea trial area

This sea trial included dynamic data such as S-111 surface current and S-112 water level information transfer, and static data such as S-101 ENC and S-102 bathymetric surface data. The Janghang/Gunsan test area has strong tidal areas. This location was analyzed and determined to be an appropriate site to test the S-10X test data in the sea trial. Furthermore, Janghang/Gunsan was selected as the test area since a regional office of KHOA is located at Janghang and KHOA Survey Ship Huang-Hai-Ro-Ho was available for the sea trial. Figure 1 displays the map of the area.

- Overview: Gunsan port was opened on 1st May 1899 as a port to transport grain from Honam pyeongya and is now the busiest trade port of the mid west. It is divided into Nae-Hang and Oe-Hang, lying at the southern part of the Geumgang river mouth.
- Cargo handling: The annual capacity of the cargo handling is 12,784,000tons. There are 10 storage warehouses, an open-air yard of area 815,000m², with a total capacity of 1,003,000tons.
- Tides: Gunsan Hang is semidiurnal (two daily high and low tides with approximately the same respective tidal height (IHO Publication C-33). The tidal range is about 720cm.
- Tidal current: The flood (ebb) current changes 0.2 ~ 0.4 hrs after low tide (0.6 hrs after high tide) and continues to 0.6 hrs after high tide (0.2 ~ 0.4 hrs after the low tide). The maximun flood(ebb) current of the average year reaches 1.0 ~ 2.4kn (1.0 ~ 2.3kn) around 3.1 hrs before high tide (3.2 ~ 3.4 before low tide).

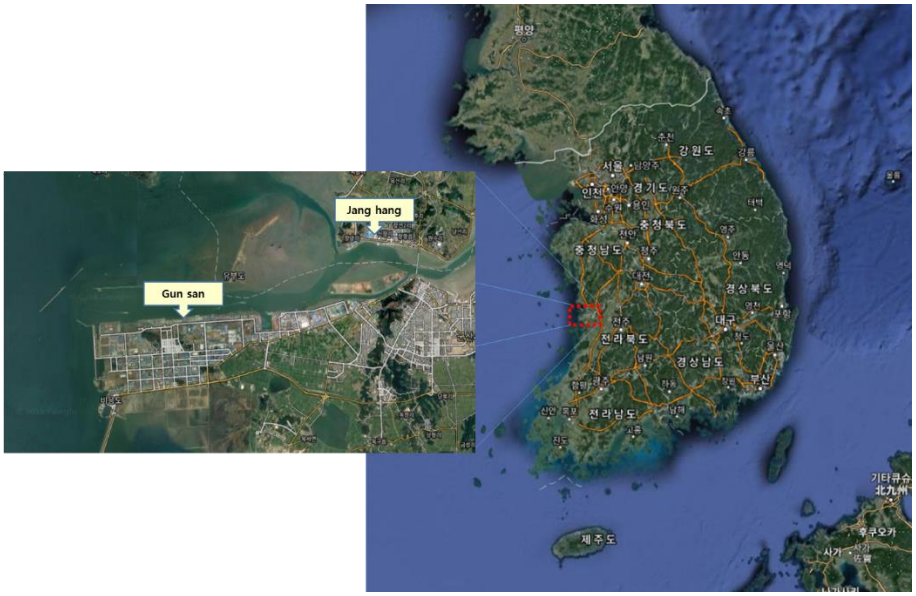

Figure 1. Map of sea trial area

2) S-10X Test Data Sets

Table 1 below is a list of S-10X TDS created by KHOA, and the versions of the product specifications used when creating the datasets. However The TDS were created only as overlays over S-101 data, and no interactions between the layers were tested.

No.	Product Name	Version	Cells	Encoding format	IHO WG
S-101	Electronic Navigational Chart	Draft 0.0.2	10	ISO/IEC 8211	S-100WG
S-102	Bathymetric surface	Draft 2.0.0	6	BAG	S-100WG
S-111	Surface currents	Working draft 1.8	11	HDF-5	TWCWG
S-112	Dynamic water level data	Draft 0.0.0 (2014)	2 tidal stations	AIS message 8	TWCWG
-	Additional bathymetric layer		2	ISO/IEC 8211	-
-	Digital list of tide		2 sets	GML	-

Table 1. List of S-10X test data sets created by KHOA

Tools and procedures to create TDS

S-101 ENC

- Tools: NOAA/ESRI S-101 Converter (Version 0.8.19), KHOA S-101 editor.
- Procedures: S-57 ENC data(ER) → S-101 Converter → Input NEW items or update via S-101 editor (see Figure 2 for a comparison between S-57 and S-101 ENCs).
- Test Data Sets: two cells for Band 4, two cells for Band 5, and six cells for Band 6.

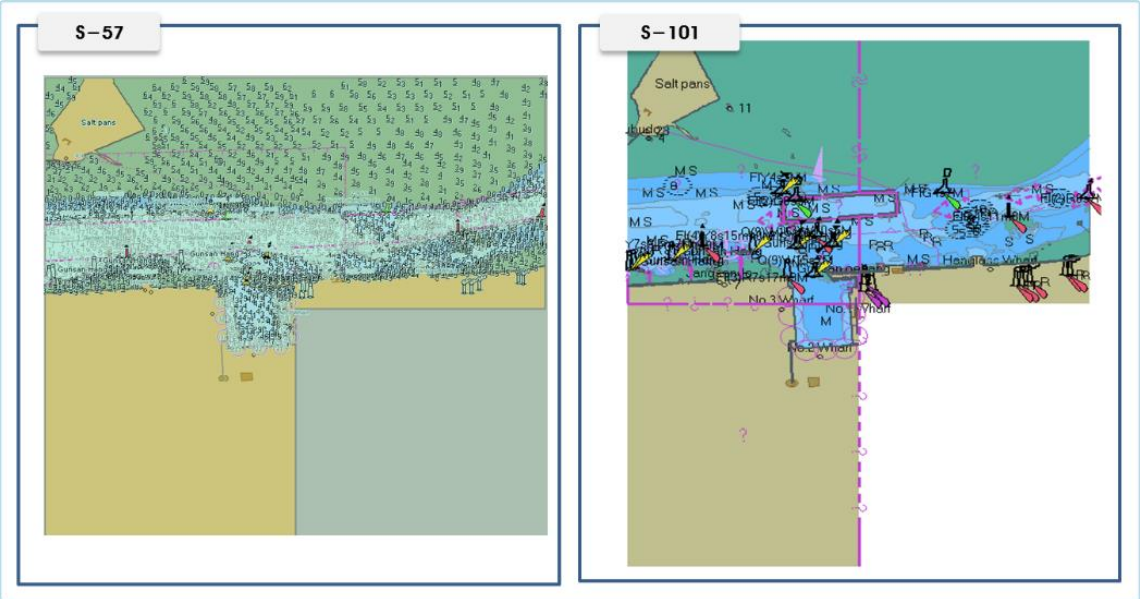

Figure 2. Comparison between S-57 ENC and S-101 ENC

S-102 Bathymetric Surface

- Tools: KHOA S-102 Editor (developed using open source application from the Open Navigation Surface Working Group).
- Procedures: Survey data → Upload to DEM Database → Converted and edited using the S-102 editor (BAG).
- Test Data Sets: six cells coverage at ENC band 6.
- Figure 3 shows an example of compilation of S-102 bathymetric surface data over S-101 ENC TDS.

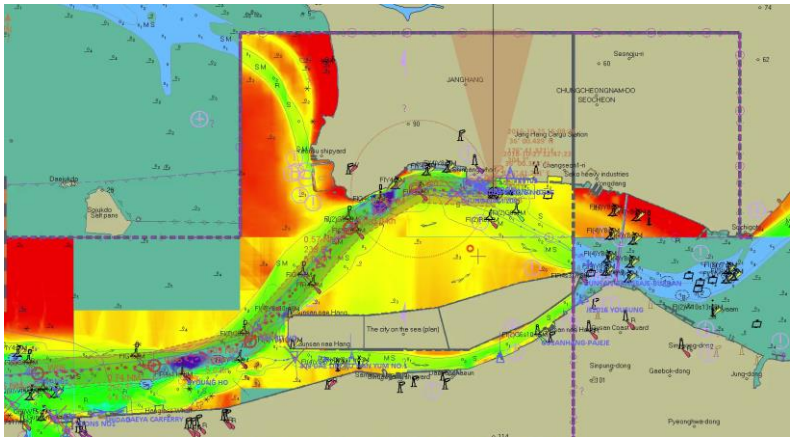

Figure 3. Example of compiling S-102 Bathymetric surface data

S-111 Surface Current

- Tools: KHOA S-111 Editor.
- Procedures: Speed and direction of surface current data (sourced by KHOA Tidal prediction S/W) → Created by KHOA S-111 Editor.
- Test Data Sets: two cells coverage at ENC band 5 and six cells coverage at ENC band 6.
- Figure 4 shows an example of compilation of S-111 surface current data over S-101 ENC TDS.

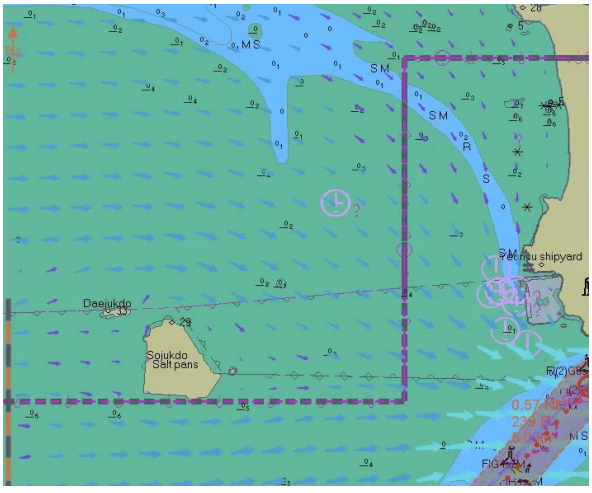

Figure 4. Example of compiling S-111 Surface current data

S-112 Dynamic Water Level Transfer

- Tools: KHOA ASM Message 8 Encoder, water level service system connecting with AtoN AIS.
- Procedures: Tidal station → Access and transfer the water level to QC system → Transfer the QC processed values to the water level service system → Encode the water level value to the ASM Message 8 → Send the Message 8 via AtoN AIS → Receive the ASM Message → Display the real time water level value in the sea trial system.
- Test Data Sets: two Water level information for Gusan tidal station and Janghang tidal station.

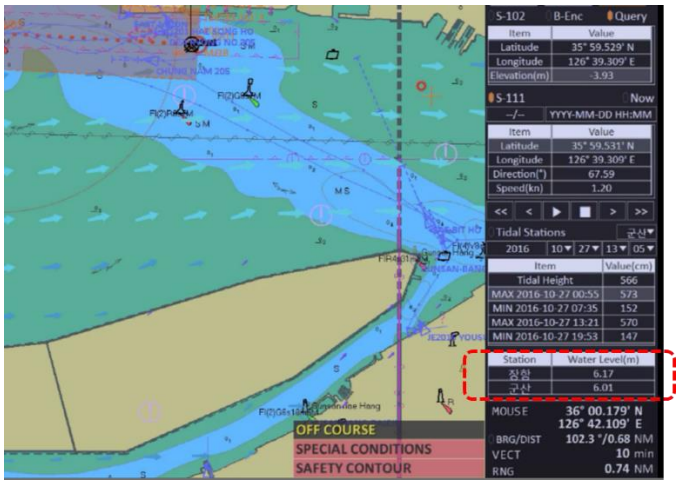

Figure 5. Example of displaying S-112 Dynamic water level

Additional Bathymetric layer

- Tools: CARIS GIS (Several tools like GeoCadMap, Fledermaus, Hypack, Surfer, ArcGIS were tested to produce additional bathymetric layers).
- Procedures: Fare sheets and ENC depth contour → Creation of 1m depth contour by CARIS GIS → Compiling depth contour → Convert the S-57 Bathy layer by S-101 Converter.
- Test Data Sets: two cells.

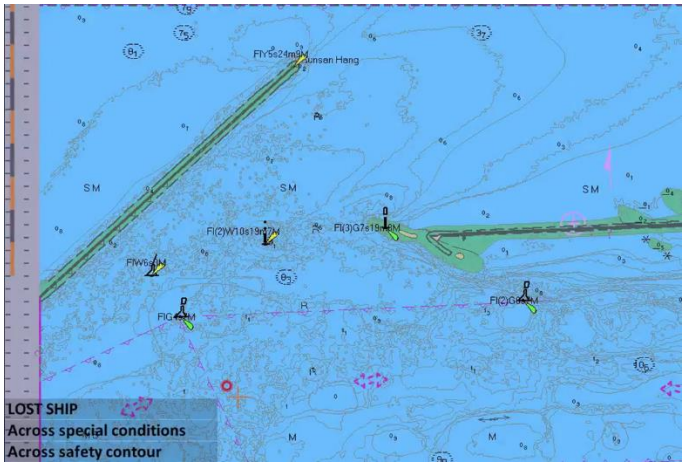

Figure 6. Example of displaying Additional Bathymetric layer

Digital list of tides

- Tools: Tidal QC system (Ocean DB), TOM & TOPS, Digital tidal list editor.
- Procedures: Tidal station → QC process (Ocean DB) → Internal management system (TOM&TOPS) → Internal format on tidal table → Convert to S-100 data (GML).
- Test Data Sets: each set for Gusan and Janghang tidal stations.

3) Sea trial system

KHOA has developed and is maintaining S-100 simple viewer which has been used in the S-100 test bed project in order to display the S-10x Data Sets. Machine readable feature and portrayal catalogues, which comply with the relevant Product Specification, have also been produced for the use in the viewer.

KHOA jointly developed the S-100 sea trial system with a Korean ECDIS OEM. This system includes the core libraries to process and display the S-10X test data sets according the machine readable catalogues and portrayal processes described in S-100 part 9. The S-100 sea trial system is equipped with the ECDIS functions such as route planning, route monitoring and AIS ASM. These were required for the purpose of sea trial. Figure 7 depicts the development of S-100 sea trial system.

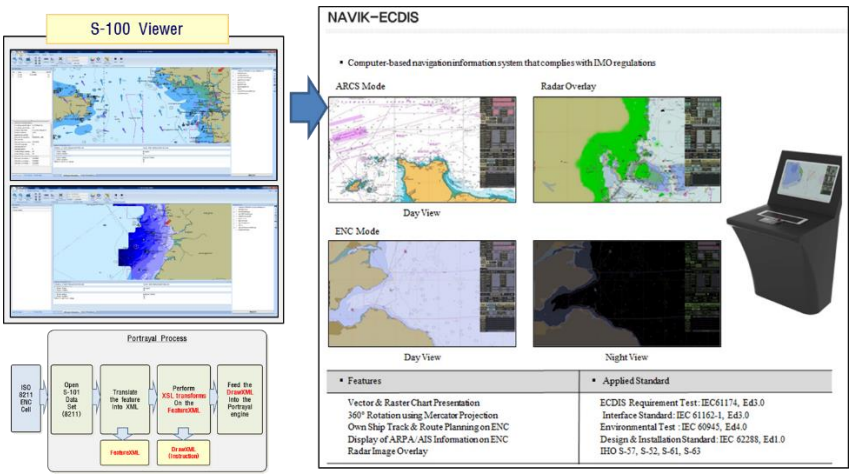

Figure 7. Development of S-100 sea trial system

Figure 8 shows a screen image from the S-100 sea trial system. The system includes several functions to turn on/off and check the detailed information in each of the product layers (e.g. S-102 Bathymetric surface, S-111 Surface current, S-112 Water level transfer, Additional bathymetric layer and Digital tidal tables). The functions are accessed on the right panel of the system display.

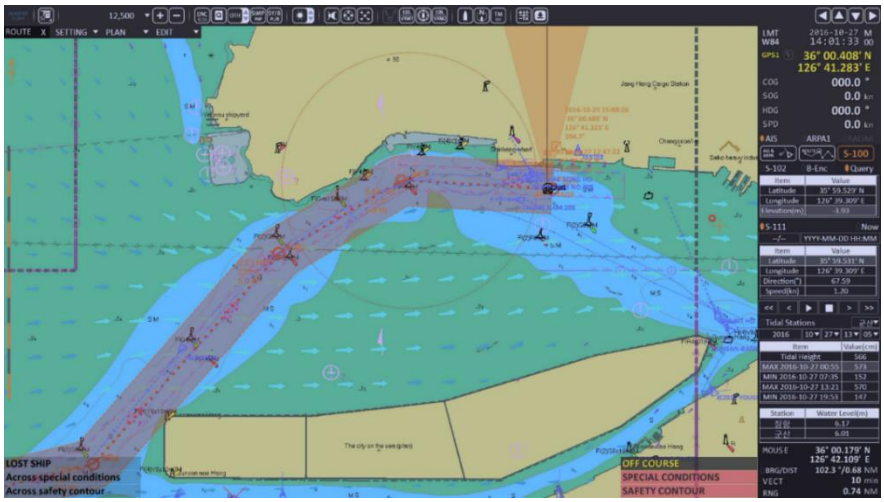

Figure 8. Screen image of S-100 sea trial system

4) Sea trial execution and preliminary results

KHOA conducted the sea trial to test the S-10X test data sets in terms of data compilation, usefulness of S-10X data, and harmonization of the display between S-10X products.

- Date: 27-28 September 2016
- Place: Janghang/Gunsan
- Vessel: KHOA Survey Ship Huang-Hai-Ro-Ho
- Testing route and duration: from Janghang to inner harbor of Gunsan (round trip in about two hours)
- S-10X test data sets: S-101 ENC, S-102 Bathymetric surface, S-111 Surface current, S-112 Water level transfer, additional bathymetric layer and digital tidal table data.

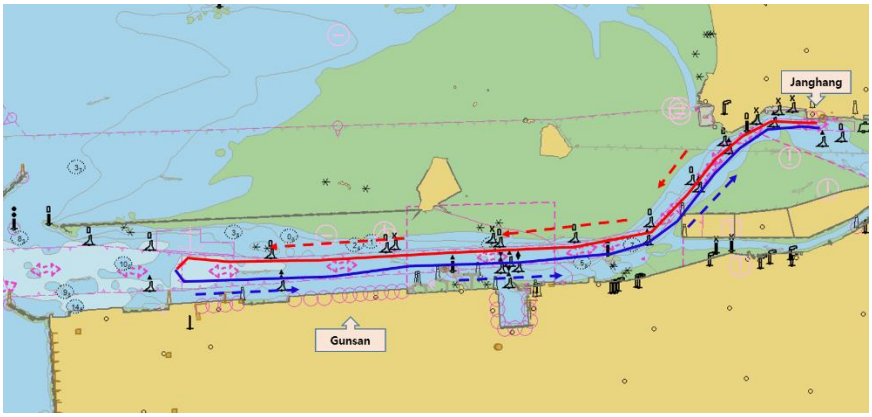

Figure 9. Testing route – Between Janghang and inner harbor of Gunsan (Round trip)

Figure 10 shows the survey vessel Huang-Hai-RO-Ho used in the sea trial and the S-100 sea trial system installed on the bridge of the vessel.

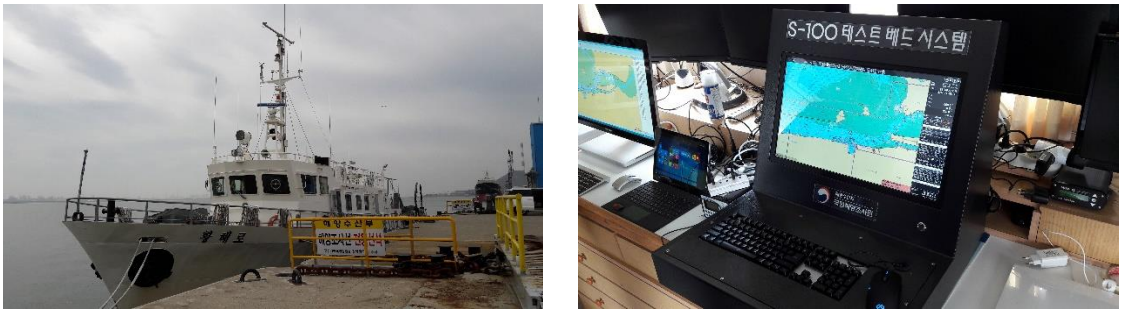

Figure 10. Survey vessel and system in the S-100 sea trial

Figure 11 shows a screen image of S-10X test data in the sea trial system. The research/test team prepared check lists of test requirement for the test data sets. The test requirement included data compilation and data display per S-10X data, harmonized display between S-10X products and functions of sea trial system.

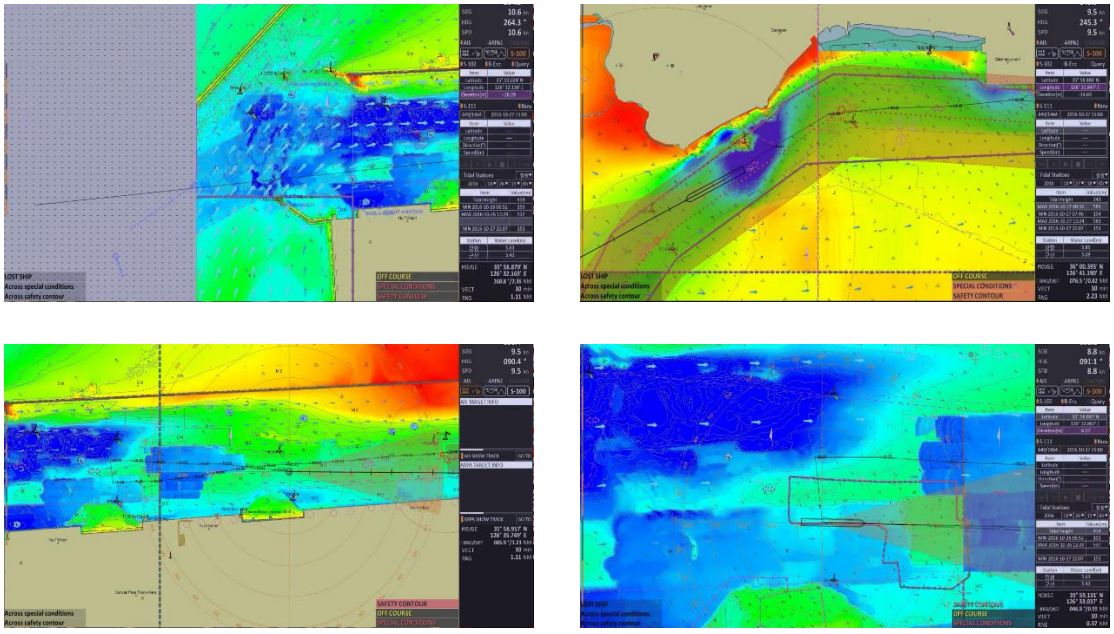

Figure 11. Screen image of S-10X test data in the sea trial system

Outcomes of the sea trials

The S-10X test data were tested via the function of querying attribute values and satisfied the requirement of the check list in general. Insufficient portrayal rules for S-101 ENC were identified as an issue in the Portrayal Catalogue. When S-111 surface current was displayed over the S-101 ENC, the arrows for surface current were not distinguished clearly against ENC symbols. It was observed that the S-112 water level value needs further consideration to determine how to apply the real time water level to the static information such as ENC and bathymetric surface. S-102 Bathymetric surface was displayed by a temporarily defined portrayal method because of the lack of S-102 portrayal rules. Portrayal rules which are to be helpful for safe navigation need to be considered like "Go area" and "No Go area".

KHOA has created 6 types of S-10X test data and conducted the sea trial using the S-100 test system. The overall results of sea trial can be summarized like below:

- Insufficient portrayal rules of S-101
- Lack of S-102 portrayal rules
- Need for harmonized display between S-101 and S-111 data
- The method of how to apply the real-time water level with S-101 ENC
- The need for interoperability rules in the system

Future Plan

The comprehensive outcomes of sea trial will be reported to the relevant WGs. KHOA will invite the WGs to provide their comments on this sea trial framework. It is planned to have a sea trial in 2017 that will focus mainly on the interoperability guideline which is under development by S-100 WG.

Conclusions

KHOA has been promoting the research project to utilize S-100 and support the S-100/S-10X test bed project of the IHO. Research conducted during 2016 focused on creation of S-10X test data sets, development of the S-100 sea trial system and conducting an S-100 sea trial. KHOA hopes that the research results can be utilized in the IHO S-100/S-10X test bed project as well as in applied to S-100 and S-10X Product Specifications in the navigational environment.