Hamburg Port Authority

# Best standardized nautical information for safe navigation in ports - the Port ENC!

**Results of the integrated EU research project EFFORTS - work package 1.3 - Port ECDIS.**

EFFORTS

June 21th - 23th 2010, Quebec – Canada

Dieter Seefeldt (Ret.)

Canadian Hydrographic Conference 2010 June 21-23 City of Québec, Quebec, CANADA

# Why a Port ECDIS – Port ENC?!

# Why a Port ECDIS – Port ENC?!

- The chart requirements for manoeuvring big ships with Minimum Under-Keel Clearance in narrow fairways (harbour access channels), within the port area and for the port maintenance **go far beyond the current ECDIS and Inland ECDIS standard** in
  - up-to-date-ness
  - quality and
  - accuracy (topography and bathymetry)
  - large scale charts
  - special chart features/objects and attributes
  - and reliability

- of **hydrographic data (Bathymetry) and geographic data (Topography).**

# Why a Port ECDIS – Port ENC?!

- For Port operations, there are special requirements for
  - **vertical and horizontal accuracy**.
- This is achieved by
  - **using modern sensor technology**.
- The **same accuracy must be inherent in the underlying electronic charts.**

Hasenpusch / Hafen Hamburg

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# Why a Port ECDIS – Port ENC?!

- Masters and Pilots, the Harbour Master, Ship's Officers, Transport Execution, Port Maintenance and other needs the best available up-to-date digital charts **(→ Port ENC's)** to obtain the required nautical information they need!

- The **Port ENC** takes into account this high level of special requirements!! (known request and the result of the **Port ECDIS questionnaire**).

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# Why a Port ECDIS – Port ENC?!

- Increasing of vessel sizes versus less harbour and manoeuvre space (vessel size in relation to fairways and basins),
- Minimum Under Keel Clearance and
- special requirements for minimum dredging
- call for the highest level of digital chart information for navigation in fairways and ports currently not being met by equipment according to **SOLAS V Carriage requirements!**

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# Why a Port ECDIS – Port ENC?!

- The situation in the Port of Hamburg

Very Large Container Carrier (VLCCs)


Very Large Cruise Liner

# Why a Port ECDIS – Port ENC?!

- The situation in the Port of Hamburg

ship operations

docking

# Why a Port ECDIS – Port ENC?!

- The situation in the Port of Hamburg

precise berthing

less manoeuvre space

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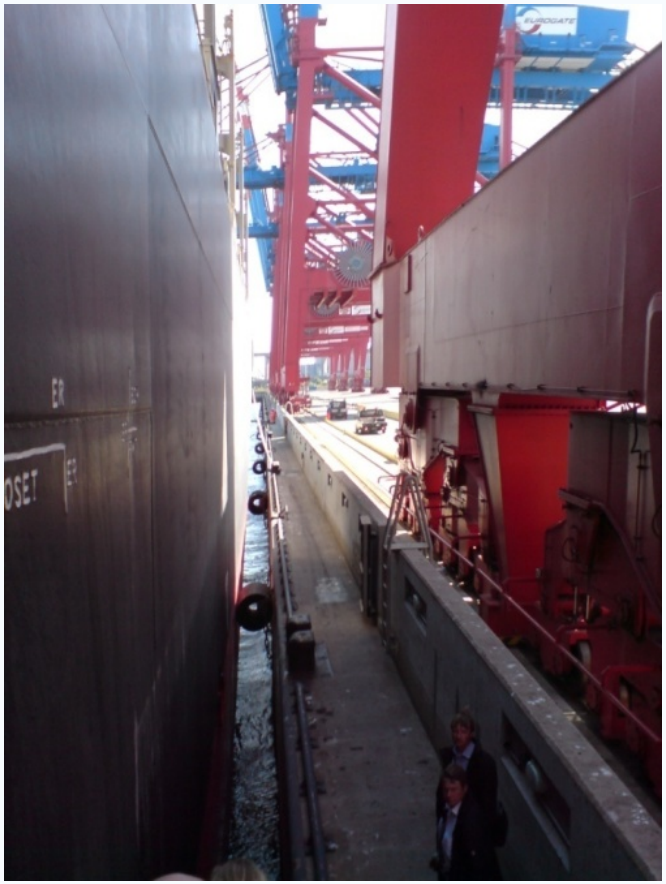

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# Why a Port ECDIS – Port ENC?!

- The situation in the Port of Hamburg


Hasenpusch / Hafen Hamburg

less manoeuvre space

bulk vessel
turning and docking

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# Why a Port ECDIS – Port ENC?!

- The **IHO ECDIS standard for maritime ENC's** and the **Inland ECDIS standard** for **Inland ENC's (IENCs)** using the same accuracy and quality definitions (→ ZOC Assessment)
- but both **without meeting the requirements ports have!**
- At present, there is **no standard or extension** considering the special requirements of port operations!
- That **call for a specific "Port ECDIS" → Port ENC.**

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# Why a Port ECDIS – Port ENC?!

- The **Port ENC standard** should be an
  - independent but complementary standard to **maritime ENC and Inland ENC.**
- The development of a **Port ENC standard** focuses on high precision operations in ports.
- A **Port ENC** intended to align with the ongoing developments for **maritime** and **Inland ENCs → S100**
- **Port ENC** data should serve as the missing link between **maritime** and **Inland ENCs**.

# IHO Standards (S-57 & S-44)

# IHO Standards (S-57 & S-44)

- **IHO Standards do not provide significant topographic source data for integration in ENCs and**
- **no dedicated accuracy requirements are defined that apply for different navigational purposes / categories (e.g., port operations)**
- Within **ENCs** and **Inland ENC's**, the IHO S-57 **Zone of Confidence (ZOC) assessment is used to describe only the quality of bathymetric data,**
- **the Zone of Confidence (ZOC) is not used for topographic data!**

# IHO Standards (S-57 & S-44)

1.Co.34 Replace the existing ZOC table and the associated comments with the following:

"ZOC Table:

**S57 ECDIS definitions (Zone of Confidence - bathymetry)**

| 1 | 2 | 3 | | 4 | 5 |
|---|---|---|---|---|---|
| ZOC [1] | Position Accuracy [2] | Depth Accuracy [3] | | Seafloor Coverage | Typical Survey Characteristics [5] |
| A1 | ± 5 m | =0.50 + 1%d | | Full area search undertaken. All significant seafloor features detected [4] and depths measured. | Controlled, systematic survey [6] high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system. |
| | | Depth (m) | Accuracy (m) | | |
| | | 10<br>30<br>100<br>1000 | ± 0.6<br>± 0.8<br>± 1.5<br>± 10.5 | | |
| A2 | ± 20 m | = 1.00 + 2%d | | Full area search undertaken. All significant seafloor features detected [4] and depths measured. | Controlled, systematic survey [6] achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder [7] and a |
| | | Depth (m) | Accuracy (m) | | |
| | | 10<br>30 | ± 1.2<br>± 1.6 | | |

highest level

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## S44 Ed. 5 new - Minimum Standards for Hydrographic Surveys - February 2008

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[illegible] is less crit[illegible] *features* of concern to surface shipping may exist. | Areas shallower than 100 [illegible]s where a general [illegible]n of the sea floor is be an issue for the type of surface shipping expected to transit the area. | Areas generally deeper than [illegible]s where a general [illegible]n 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<br>b = 0.0075 | a = 0.5 metre<br>b = 0.013 | a<br>b | |
| Glossary and note 2 | ***Full Sea floor Search*** | Required | Required | | |
| Para 2.1<br>Para 3.4<br>Para 3.5<br>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 | | |
| 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<br>m<br>F<br>sp | |
| 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 | | |
| Chapter 2 and note 5 | **Mean position of floating aids to navigation (95% *Confidence level*)** | 10 metres | 10 metres | 10 metres | 20 metres |

used for the Port of Hamburg

S57 ECDIS ZOC +/- 5m
versus
IHO S44 Special Order
+/- 2m

Mismatch between IHO S57 ECDIS Requirements and S44 Special Order!

quay walls, bridges, locks etc. ?!

# IHO Standards (S-57 & S-44)

- One example is the **official ENC of Hamburg.**
  - Produced and issued by BSH (Federal Maritime and Hydrographic Agency / Germany),
  - it **meets all the relevant ENC related standards** and **fulfills the requirements for maritime navigation (SOLAS V carriage requirements),**
    - but the ENC is too small in scale,
    - does not have any bathymetric detail,
    - not showing up-to-date information
    - and poorly defined horizontal accuracy for topographic features such as quay walls, piers, pontoons, etc.

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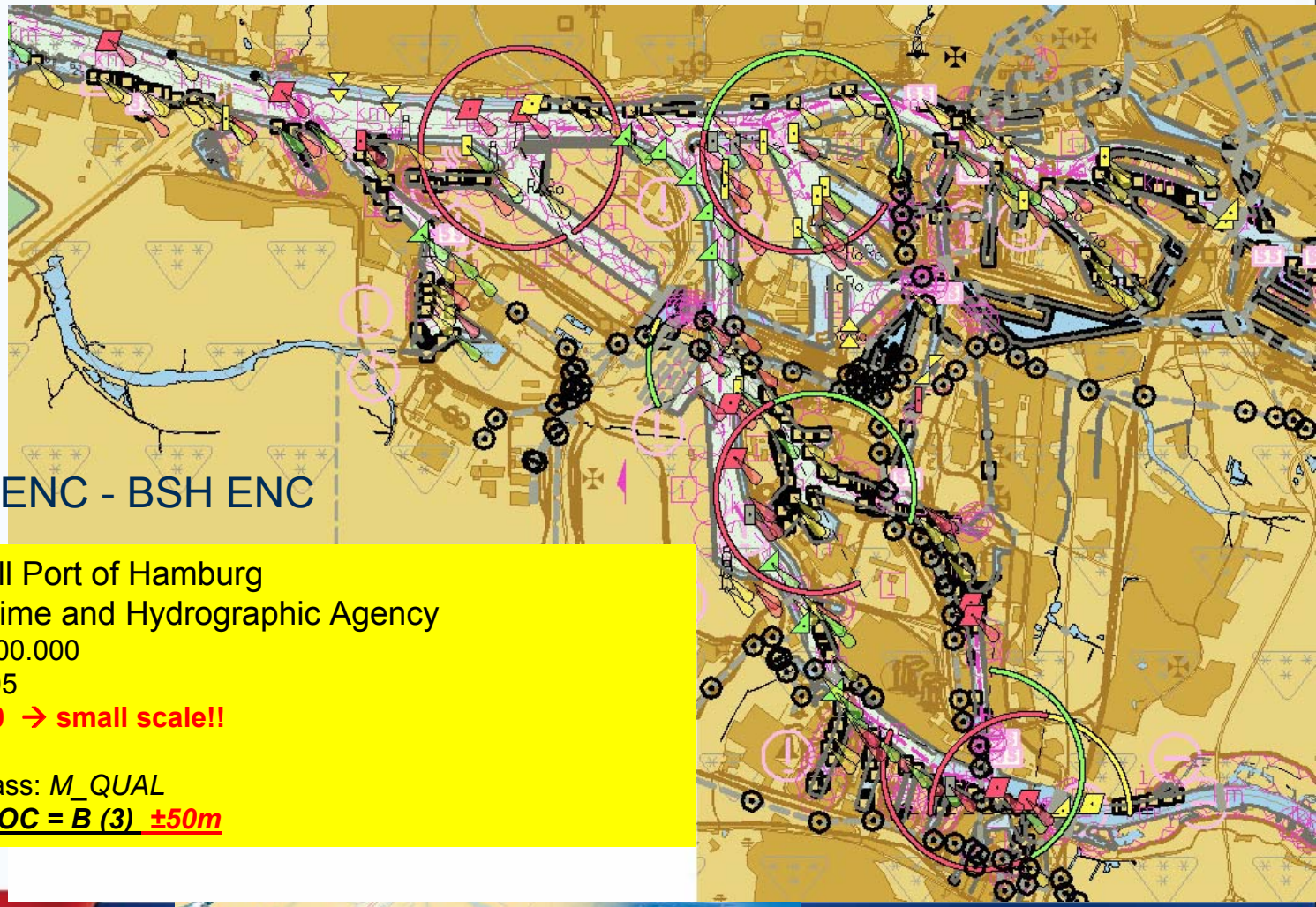
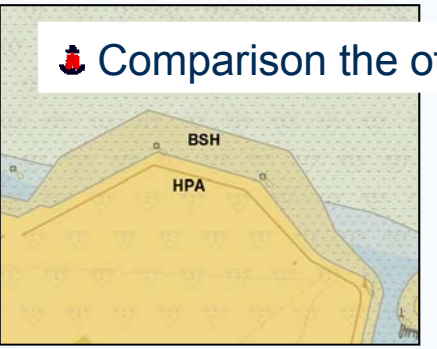
# Comparison
# HPA Basis Port ENC - BSH ENC

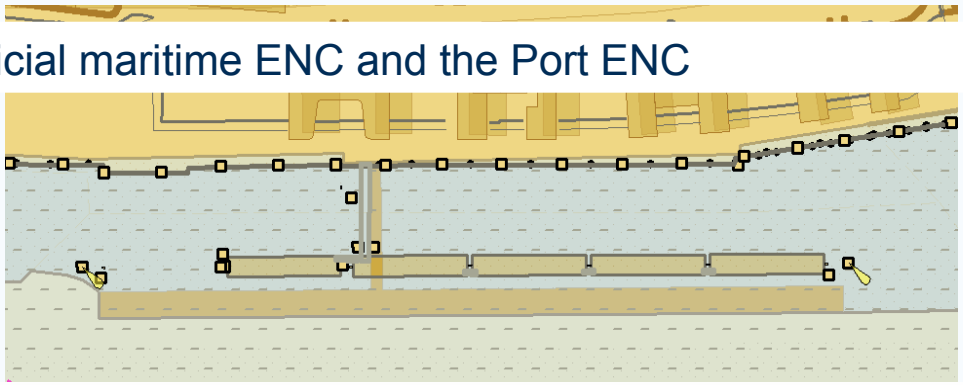


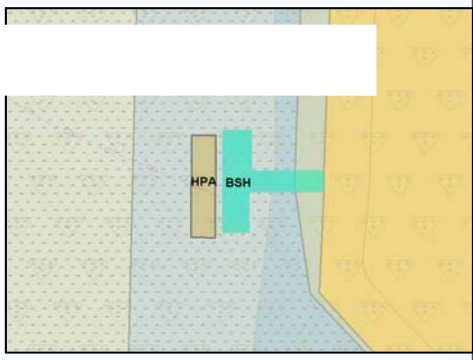
BSH ENC-cell Port of Hamburg
Federal Maritime and Hydrographic Agency
*name:* DE521500.000
*date:* 27.05.2005
**scale: 1:15 000 → small scale!!**
*accuracy:*
S-57 Object Class: *M_QUAL*
**attribut: *CATZOC = B (3)* *±50m***

# IHO Standards (S-57 & S-44)

- Comparison the official maritime ENC and the Port ENC






| | | Differences HPA - BSH | | |
|---|---|---|---|---|
| | | East (m) | North (m) | Distance (m) |
| Fixed marks / navigational aids | Average | -0,01 | 0,01 | 0,01 |
| | MIN | -0,19 | -0,62 | 0,02 |
| | MAX | 0,15 | 0,56 | 0,62 |
| Quay wall corner | Average | -4,75 | -3,65 | 7,79 |
| | MIN | -13,93 | -17,15 | 2,42 |
| | MAX | 6,84 | 4,35 | 17,67 |
| Pontoon corner | Average | 1,60 | -2,89 | 8,05 |
| | MIN | -11,00 | -11,69 | 3,84 |
| | MAX | 10,42 | 19,74 | 22,30 |

**the official BSH - ENC has a different purpose to meet (usage band 5 - harbour)!**

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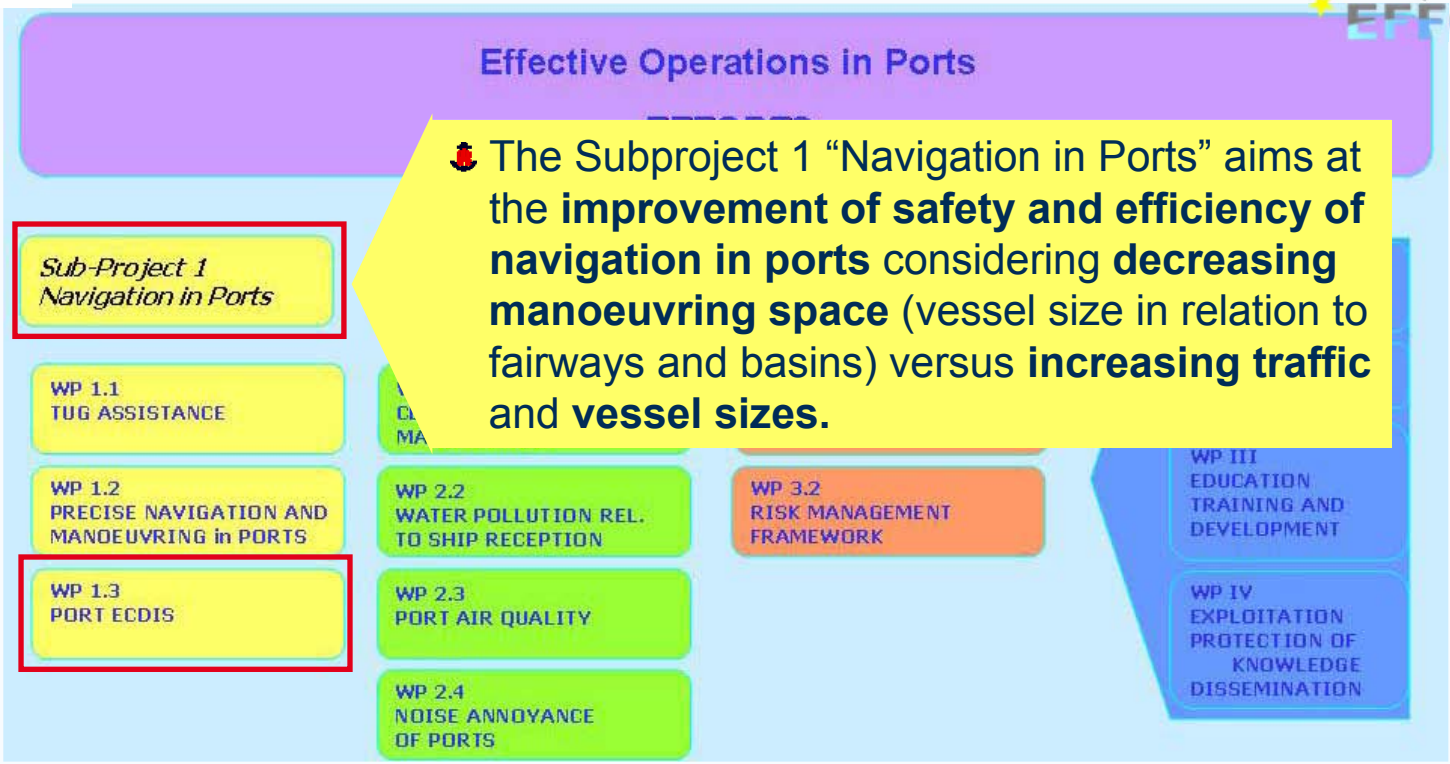
# The integrated EU research project EFFORTS

Project acronym: **EFFORTS**
Project title: **Effective Operation in Ports**

EFFORTS

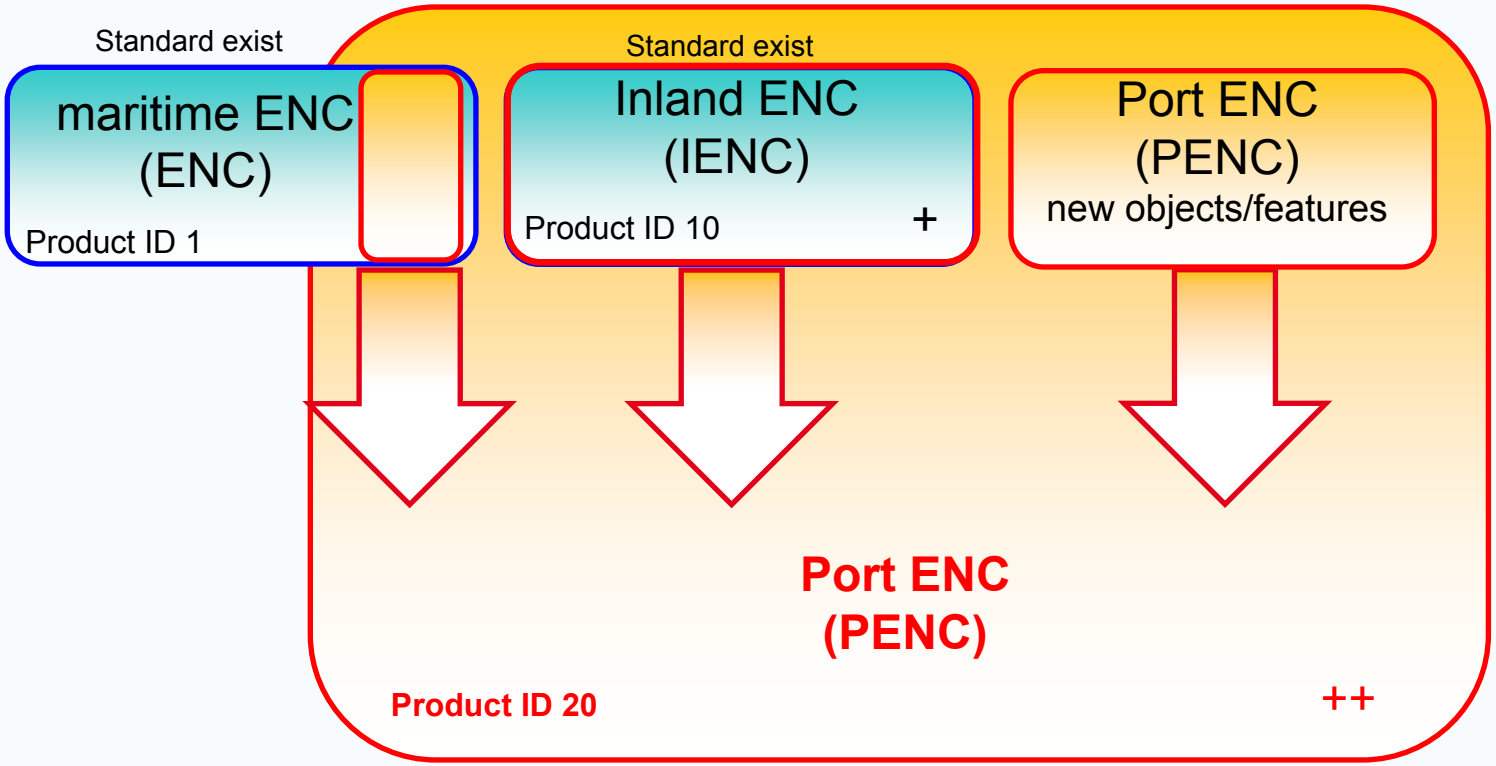



- The Subproject 1 “Navigation in Ports” aims at the **improvement of safety and efficiency of navigation in ports** considering **decreasing manoeuvring space** (vessel size in relation to fairways and basins) versus **increasing traffic** and **vessel sizes.**

# The EFFORTS Work Package 1.3 - Port ECDIS results

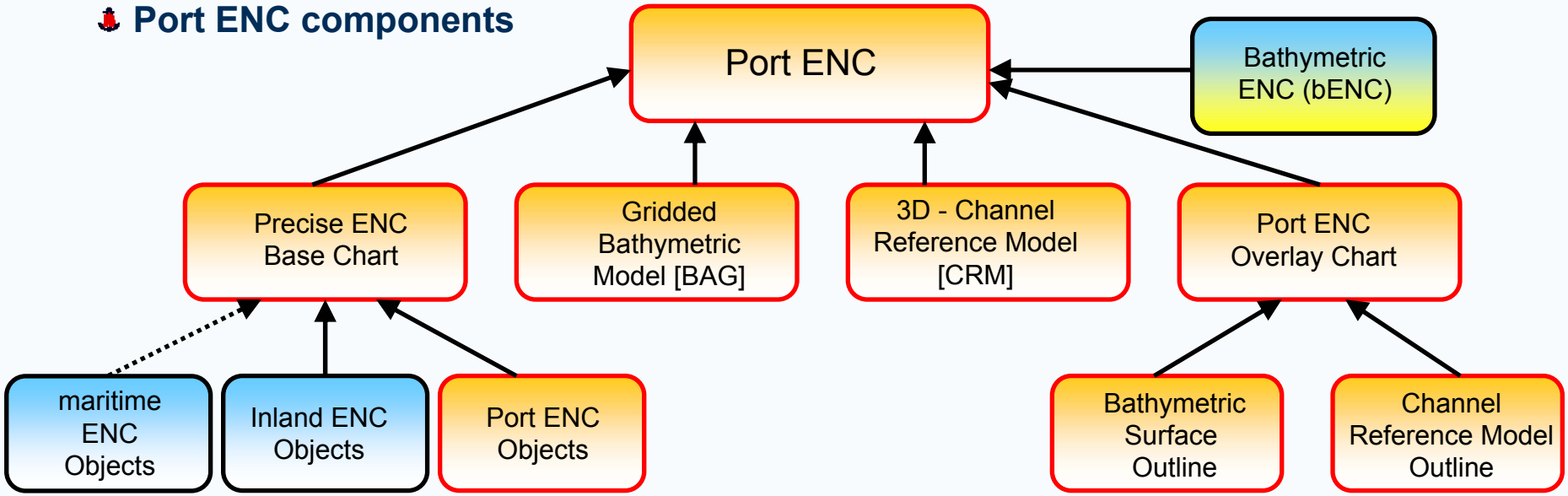
# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Gradation of the S-57 ENC products**



# The EFFORTS Work Package 1.3 - Port ECDIS results

## Port ENC components




As part of the EFFORTS project, there are a number of new port specific objects, as well as requirements for the accuracy of these objects. These new requirements will ensure that the Port ENC makes the most accurate data available to the port users.

The use of gridded bathymetry, channel outlines and channel depth model data will allow the users of the Port ENC to have an accurate and up to date 3 D information of the depth situation within the port. This will improve both, safety of navigation as well as port maintenance.

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Document about "Potential users and requirements" (structured questionnaire, study)**
- **Definition of present Data Quality in Standards used for ENC data (S57 versus S44 standard) – the current situation**
- **Port ENC specification documents**
- **Port ENC Feature Catalogue → description of the Port ENC features**
- **Port ENC Encoding guide → representation and symbolisation**
- **Port ENC Product specification**
- **Port ENC prototype (software and dataset) → Port of Hamburg**
- **including a Port ENC viewer**
- **Tests with Port ENC prototype (based on basic dataset) and evaluation of tests (report)**
- **Port ENC follow-up requirements document**

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Results - overview:**
  - For Port operations a new port related dataset, a **precise Port ENC,** is needed and required (→ result of the **Port ECDIS questionnaire**).
  - **high accuracy charts** (for using RTK-DGPS, local RTK - DGPS services deliver cm accuracy, position must fulfil or be better than IHO - S44 Special Order)
  - **large scale information** (1:500 up to 1:5000) with up to date information including special objects / features such as e.g. fenders, fender line etc. for special port navigation and operation
  - **3 D possibilities** (Grid / Raster / TIN)
  - a designed / constructed **3D - Channel Reference Model (CRM)** → the theoretical harbour bottom that must be maintained e.g. for dredged areas

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Port ENC bathymetric data quality – suggestion → CATZOC → accuracy**

Object Class: **Accuracy of ENC data**

Acronym: **m_aenc**

Set Attribute_A: **batacc**; **topacc**;
Set Attribute_B: INFORM; NINFOM; **ntxtds**; **txtdsc**;
Set Attribute_C: RECDAT; RECIND; SORDAT; SORIND;

The attribute batacc is from the type "enumerated". There is one attribute value, this value is based on the IHO Standards for Hydrographic Surveys (Special Publication N° 44 Ed.5) and be called Special.

S44 Ed. 5 (new)

Minimum Standards for

Hydrographic Surveys

February 2008

Hydrographic survey

batacc

| ID | Meaning | Max. allowable THU | Max. allowable TVU |
|---|---|---|---|
| 1 | Special | ±2 m | a = 0.25 m<br>b = 0.0075 |

Tab.1: allowable uncertainty for bathymetric data

represents the IHO S44 SO

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Port ENC geo-/topographic data quality – suggestion → CATZOC → accuracy**

topacc Zone A

| ID | Meaning | Object class | Positional accuracy | Vertical accuracy | Group |
|---|---|---|---|---|---|
| 1 | Zone A | (BCNCAR), (bcncar), (BCNISD), (bcnisd), BCNLAT, bcnlat, (BCNSAW), (bcnsaw), (BCNSPP), (bcnspp), **bridge**, **cblohd**, clrseg, DRYDOC, FLODOC, flodoc, GATCON, gatcon, HULKES, hulkes, lokbsn, MORFAC, PILPNT, **pipohd**, PONTON, ponton, PYLONS, SLCONS, slcons | ± 0,1 m | **± 0,1 m** | Fixed object relevant for berthing, docking and lock passage |
| | | berths, BUISGL, HRBFAC, hrbfac, LNDMRK, NAVLNE, (RADLNE), RADSTA, RESARE, resare, (RSCSTA), RTPBCN, SILTNK, sistat, sistaw | ± 0,5 m | **± 0,5 m** | Fixed object relevant for navigation (maneuver-ing, turning, towage) |

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Port ENC geo-/topographic data quality – suggestion → CATZOC → accuracy**

topacc Zone B

| ID | Meaning | Object class | Positional accuracy | Vertical accuracy | Group |
|---|---|---|---|---|---|
| 2 | Zone B | (BCNCAR), (bcncar), (BCNISD), (bcnisd), BCNLAT, bcnlat, (BCNSAW), (bcnsaw), (BCNSPP), (bcnspp), **bridge**, **cblohd**, clrseg, DRYDOC, FLODOC, flodoc, GATCON, gatcon, HULKES, hulkes, lokbsn, MORFAC, PILPNT, **pipohd**, PONTON, ponton, PYLONS, SLCONS, slcons | ± 0,5 m | **± 0,5 m** | Fixed object relevant for berthing, docking and lock passage |
| | | berths, BUISGL, HRBFAC, hrbfac, LNDMRK, NAVLNE, (RADLNE), RADSTA, RESARE, resare, (RSCSTA), RTPBCN, SILTNK, sistat, sistaw | ± 2,5 m | **± 2,5 m** | Fixed object relevant for navigation (maneuver-ing, turning, towage) |

**Tab.2: The characteristic of the attribute "Accuracy of topographic data"**

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Port ENC encoding guide → CATZOC → accuracy**
  - representation and
  - symbolisation

**Port ENC** highest quality level →

**Port ENC** second highest quality level →

| ID | | S-52 representation |
|---|---|---|
| bathymetric | topographic | |
| 1 | 1 |   |
| 1 | 2 |   |

Tab.3: S-52 representation for the meta object "Accuracy of ENC data"

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **A lot of accuracy and functional tests using the new Port ENC dataset were carried out in the Port of Hamburg (report):**
  - That means: accuracy and functional tests onboard of a **survey vessel**, tests during **docking manoeuvres** of cruise liners, test onboard of a **Trailer Suction Hopper Dredger**, tests onboard of a **Large Container Carrier using a PPU** (Marimatech)**,** functional test using the **Port ENC** as base information in the **Port of Hamburg VTMIS** (ATLAS MS)

- **Remark:**
  - **All the tests running very successful**
  - **Delivering very promising results**
  - **Demonstrating the outstanding quality and accuracy of the developed Port ENC!!**

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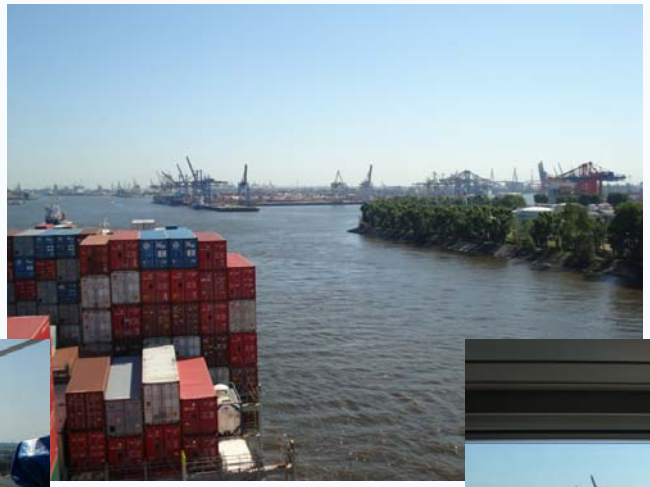
# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Example: PPU (Marimatech) test onboard of a Container vessel (VLCC)**

**Container Vessel → Yang Ming Uberty (Lenght 333.5m - Breadth 42.8m - Draught: 11.0m).**

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Example: PPU (Marimatech) test onboard of a Container vessel (VLCC)**

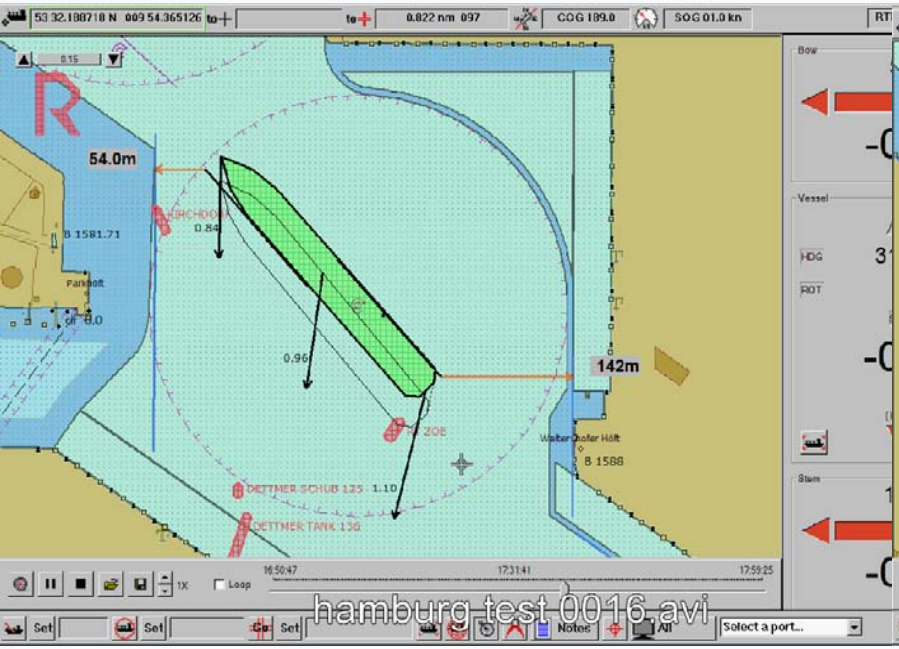


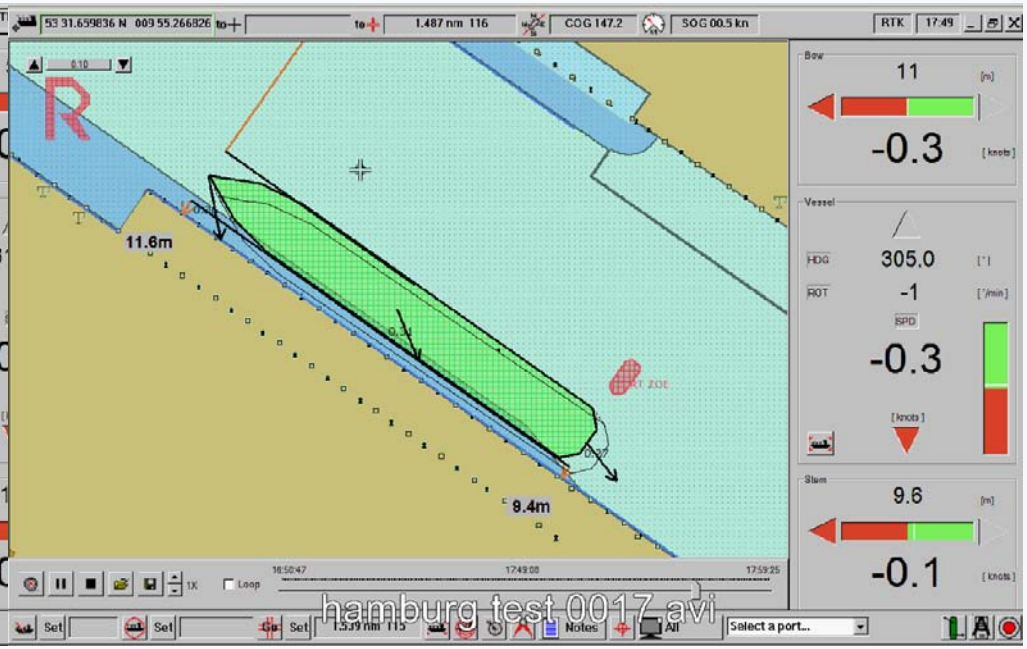
# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Example: PPU (Marimatech) test onboard of a Container vessel (VLCC)**

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **Example: PPU (Marimatech) test onboard of a Container vessel (VLCC)**



# The EFFORTS Work Package 1.3 - Port ECDIS results

- **We think that the Port ENC** – could/must be a core component for **e-Navigation**

IMO

**DRAFT STRATEGY FOR THE DEVELOPMENT AND IMPLEMENTATION OF E-NAVIGATION**

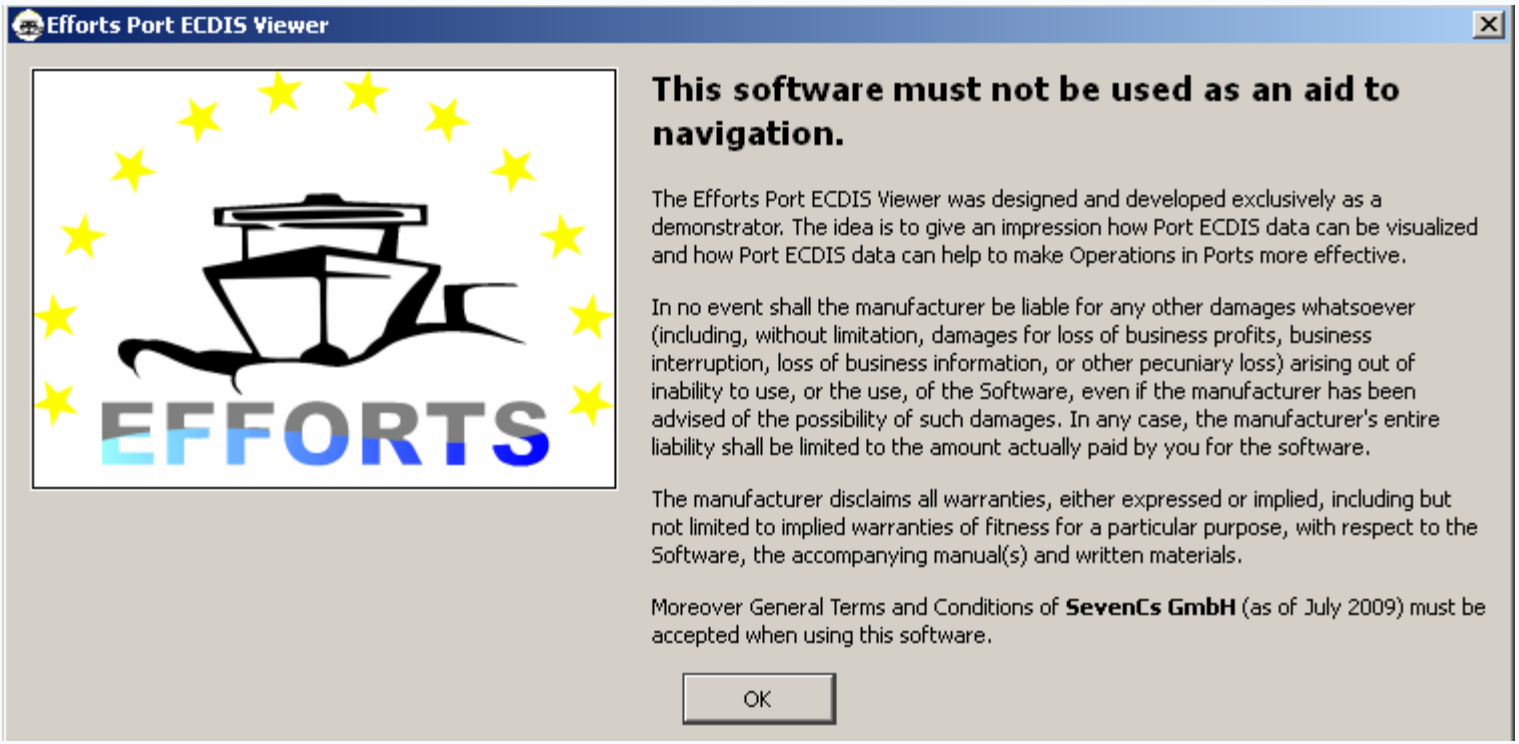
**1 DEFINITION AND SCOPE**

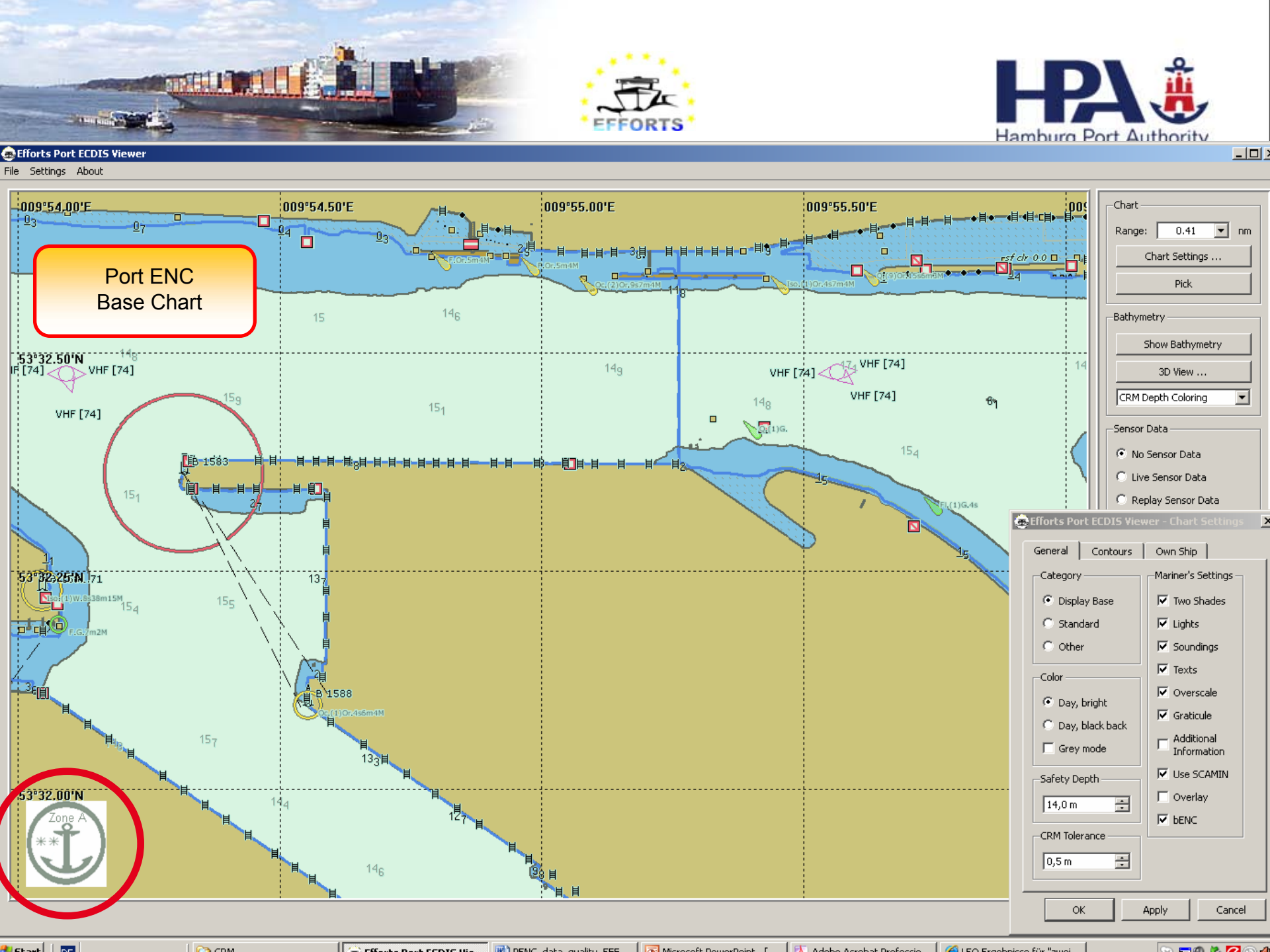
1.1 E-navigation is the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.

1.2 E-navigation is intended to meet present and future user needs through harmonization of marine navigation systems and supporting shore services.

# The EFFORTS Work Package 1.3 - Port ECDIS results

- **the Port ENC & the Port ECDIS viewer - examples**




EFFORTS
HPA
Hamburg Port Authority
Efforts Port ECDIS Viewer
File Settings About
Port ENC
Base Chart
009°54.00'E
009°54.50'E
009°55.00'E
009°55.50'E
53°32.50'N
53°32.25'N
53°32.00'N
VHF [74]
B 1583
B 1588
Zone A
Chart
Range: 0.41 nm
Chart Settings ...
Pick
Bathymetry
Show Bathymetry
3D View ...
CRM Depth Coloring
Sensor Data
No Sensor Data
Live Sensor Data
Replay Sensor Data
Efforts Port ECDIS Viewer - Chart Settings
General
Contours
Own Ship
Category
Display Base
Standard
Other
Color
Day, bright
Day, black back
Grey mode
Safety Depth
14,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
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Texts
Overscale
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Additional Information
Use SCAMIN
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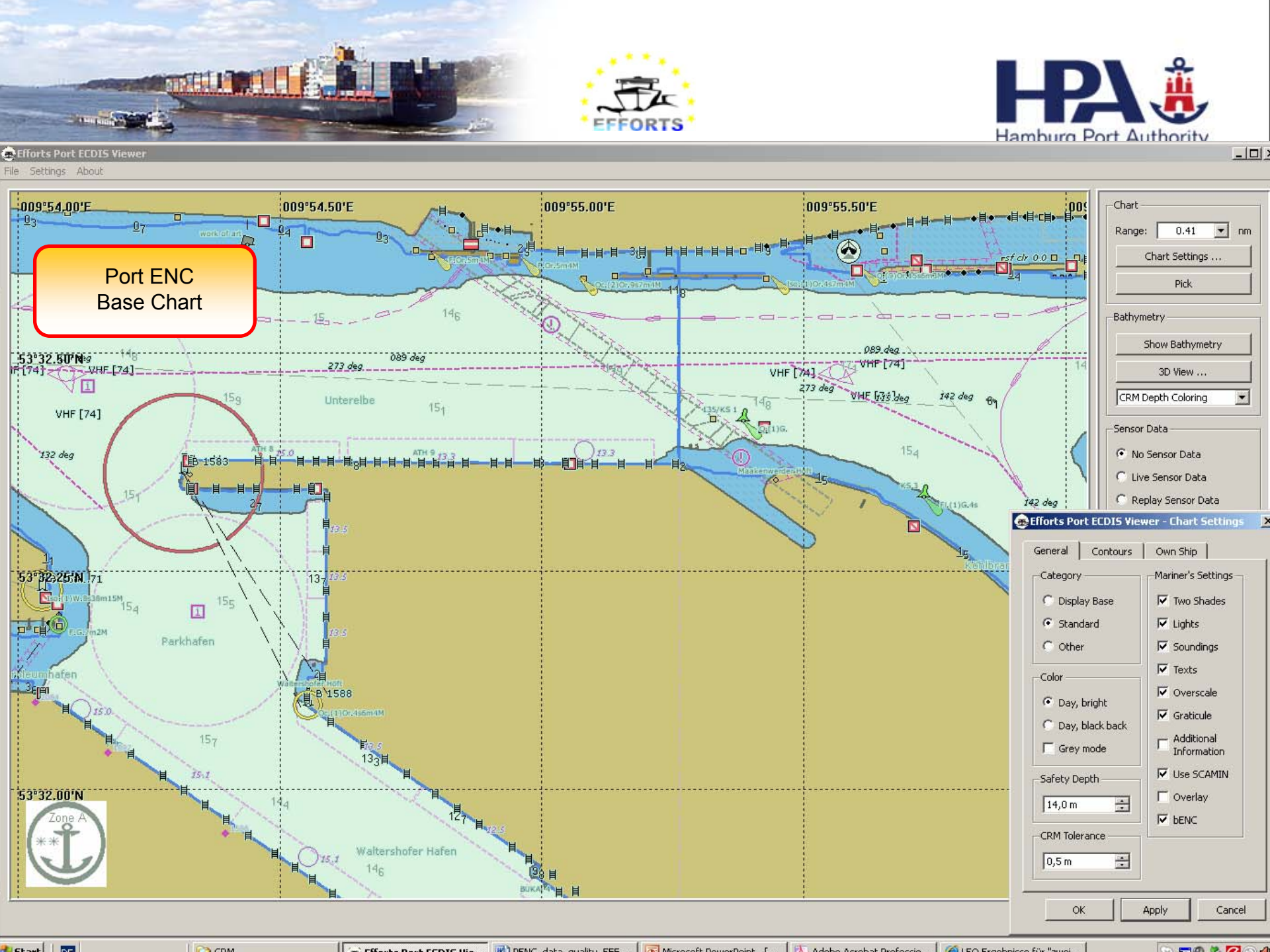
bENC
OK
Apply
Cancel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Hamburg Port Authority
Efforts Port ECDIS Viewer
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Efforts Port ECDIS Viewer - Chart Settings
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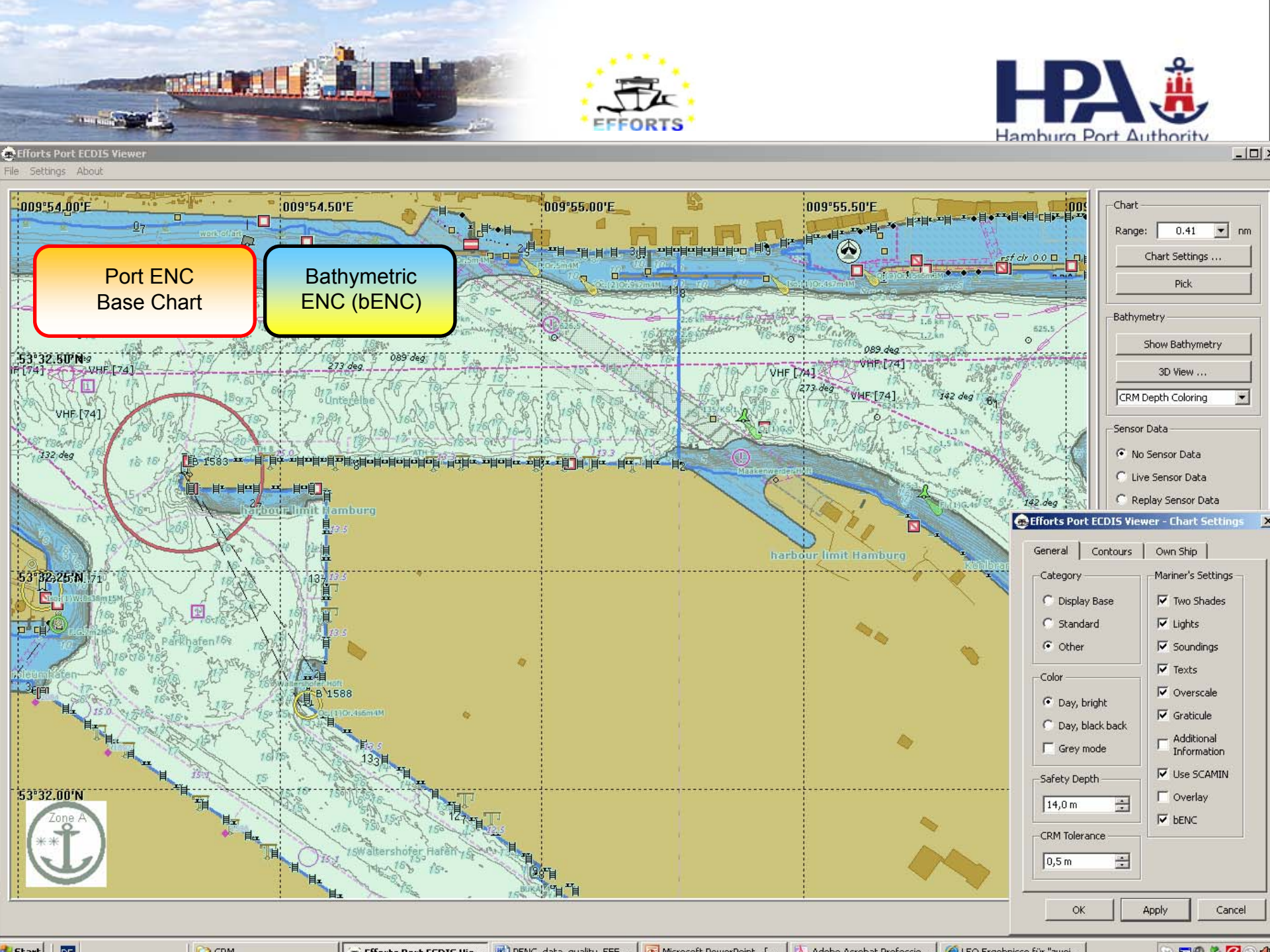
Own Ship
Category
Display Base
Standard
Other
Color
Day, bright
Day, black back
Grey mode
Safety Depth
14,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
Lights
Soundings
Texts
Overscale
Graticule
Additional Information
Use SCAMIN
Overlay
bENC
OK
Apply
Cancel


EFFORTS
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Hamburg Port Authority
Efforts Port ECDIS Viewer
File Settings About
Port ENC Base Chart
Bathymetric ENC (bENC)
009°54.00'E
009°54.50'E
009°55.00'E
009°55.50'E
53°32.50'N
53°32.25'N
53°32.00'N
harbour limit Hamburg
Parkhafen
Waltershofer Hafen
Zone A
Chart
Range: 0.41 nm
Chart Settings ...
Pick
Bathymetry
Show Bathymetry
3D View ...
CRM Depth Coloring
Sensor Data
No Sensor Data
Live Sensor Data
Replay Sensor Data
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General
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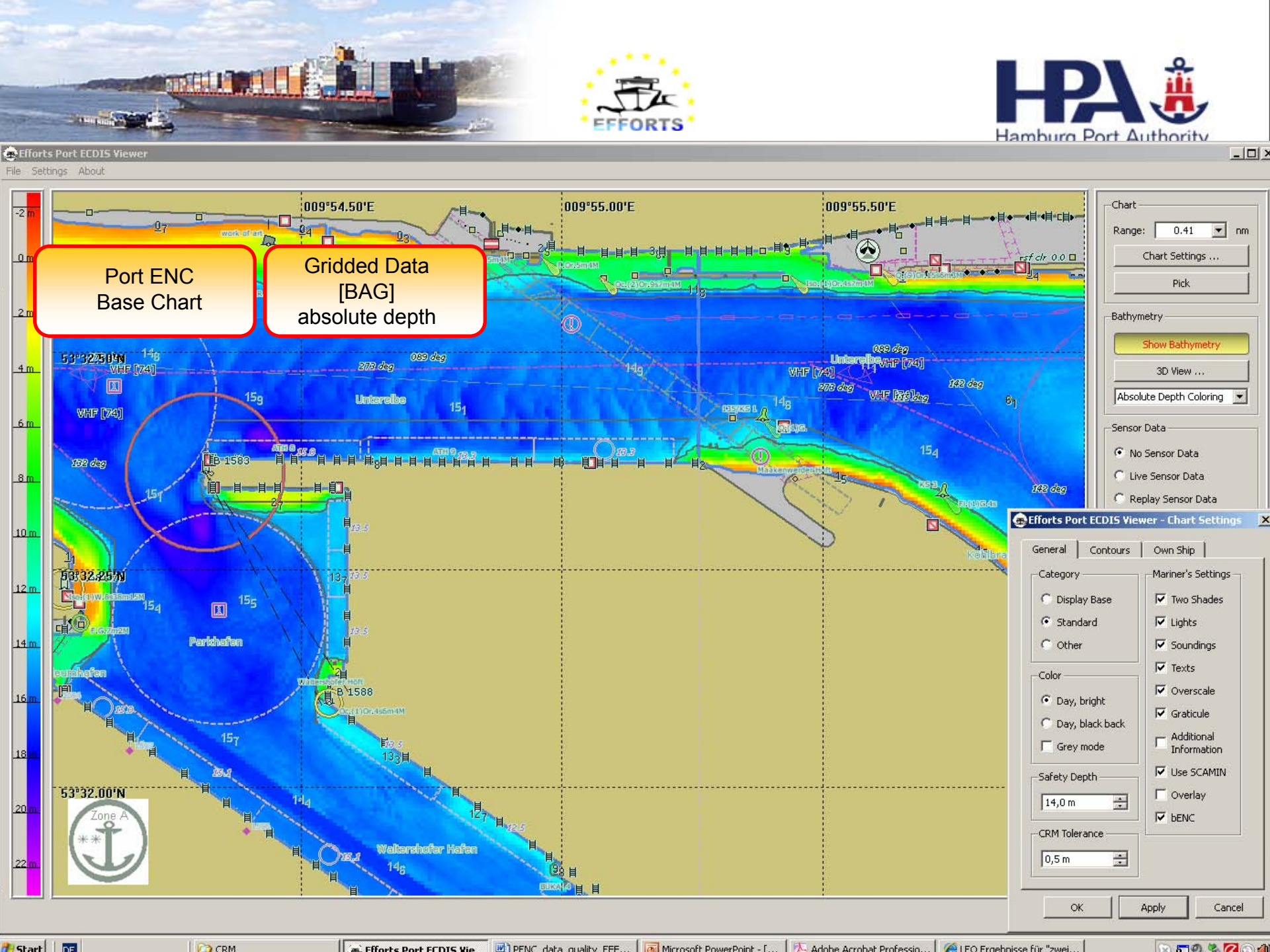
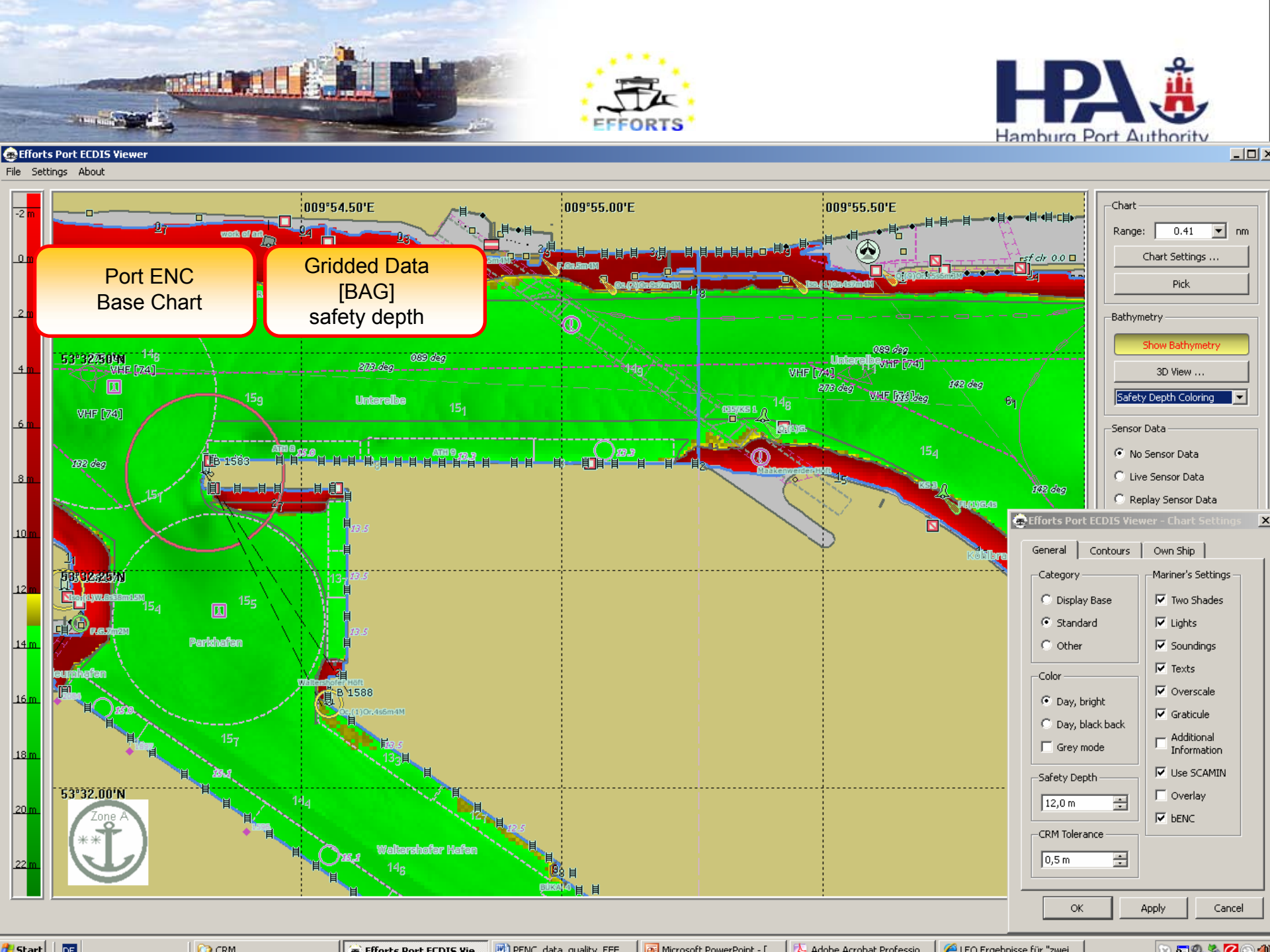
Day, bright
Day, black back
Grey mode
Safety Depth
14,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
Lights
Soundings
Texts
Overscale
Graticule
Additional Information
Use SCAMIN
Overlay
bENC
OK
Apply
Cancel


EFFORTS
HPA
Hamburg Port Authority
Efforts Port ECDIS Viewer
File Settings About
Port ENC
Base Chart
Gridded Data
[BAG]
absolute depth
009°54.50'E
009°55.00'E
009°55.50'E
53°32.75'N
53°32.25'N
53°32.00'N
Unterelbe
Parkhafen
Waltershofer Hafen
VHF [74]
B 1583
B 1588
Zone A
Chart
Range: 0.41 nm
Chart Settings ...
Pick
Bathymetry
Show Bathymetry
3D View ...
Absolute Depth Coloring
Sensor Data
No Sensor Data
Live Sensor Data
Replay Sensor Data
Efforts Port ECDIS Viewer - Chart Settings
General
Contours
Own Ship
Category
Display Base
Standard
Other
Color
Day, bright
Day, black back
Grey mode
Safety Depth
14,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
Lights
Soundings
Texts
Overscale
Graticule
Additional Information
Use SCAMIN
Overlay
bENC
OK
Apply
Cancel


EFFORTS
HPA
Hamburg Port Authority
Efforts Port ECDIS Viewer
File Settings About
Port ENC
Base Chart
Gridded Data
[BAG]
safety depth
009°54.50'E
009°55.00'E
009°55.50'E
53°32.50'N
53°32.25'N
53°32.00'N
Unterelbe
Parkhafen
Waltershofer Hafen
Zone A
Chart
Range: 0.41 nm
Chart Settings ...
Pick
Bathymetry
Show Bathymetry
3D View ...
Safety Depth Coloring
Sensor Data
No Sensor Data
Live Sensor Data
Replay Sensor Data
Efforts Port ECDIS Viewer - Chart Settings
General
Contours
Own Ship
Category
Display Base
Standard
Other
Color
Day, bright
Day, black back
Grey mode
Safety Depth
12,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
Lights
Soundings
Texts
Overscale
Graticule
Additional Information
Use SCAMIN
Overlay
bENC
OK
Apply
Cancel

EFFORTS

HPA Hamburg Port Authority

Efforts Port ECDIS Viewer

File Settings About

Port ENC Base Chart

Channel Reference Model

009°54.00'E 009°54.50'E 009°55.00'E 009°55.50'E

53°32.50'N

53°32.25'N

53°32.00'N

VHF [74]

B 1583

B 1588

Zone A

Chart

Range: 0.41 nm

Chart Settings ...

Pick

Bathymetry

Show Bathymetry

3D View ...

Safety Depth Coloring

Sensor Data

No Sensor Data

Live Sensor Data

Replay Sensor Data

Efforts Port ECDIS Viewer - Chart Settings

General Contours Own Ship

Category

Display Base

Standard

Other

Color

Day, bright

Day, black back

Grey mode

Safety Depth

12,0 m

CRM Tolerance

0,5 m

Mariner's Settings

Two Shades

Lights

Soundings

Texts

Overscale

Graticule

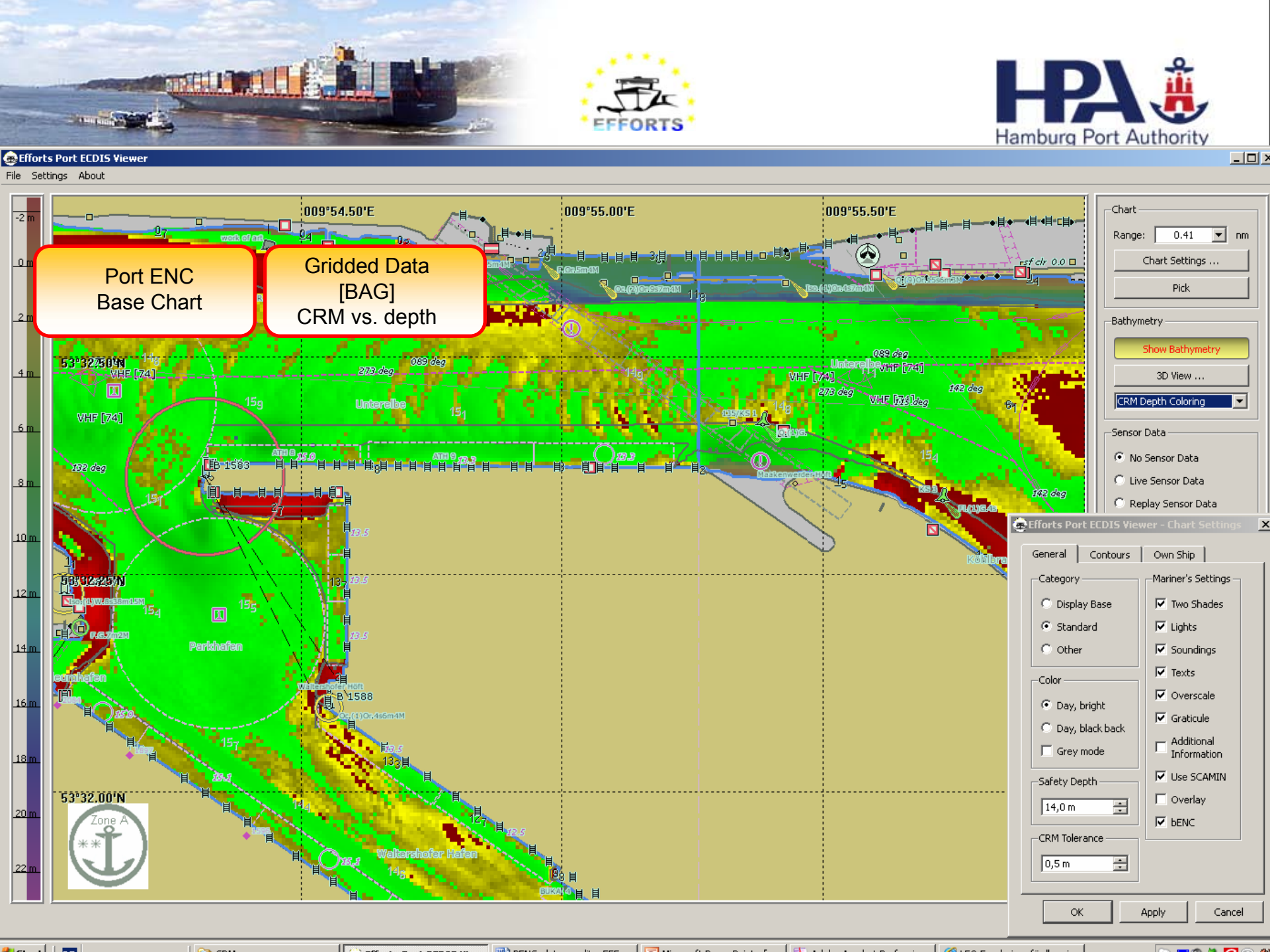
Additional Information

Use SCAMIN

Overlay

bENC

OK Apply Cancel


EFFORTS
HPA
Hamburg Port Authority
Efforts Port ECDIS Viewer
File
Settings
About
Port ENC
Base Chart
Gridded Data
[BAG]
CRM vs. depth
009°54.50'E
009°55.00'E
009°55.50'E
53°32.50'N
53°32.25'N
53°32.00'N
Chart
Range:
0.41
nm
Chart Settings ...
Pick
Bathymetry
Show Bathymetry
3D View ...
CRM Depth Coloring
Sensor Data
No Sensor Data
Live Sensor Data
Replay Sensor Data
Efforts Port ECDIS Viewer - Chart Settings
General
Contours
Own Ship
Category
Display Base
Standard
Other
Color
Day, bright
Day, black back
Grey mode
Safety Depth
14,0 m
CRM Tolerance
0,5 m
Mariner's Settings
Two Shades
Lights
Soundings
Texts
Overscale
Graticule
Additional Information
Use SCAMIN
Overlay
bENC
OK
Apply
Cancel
Zone A
Unterelbe
Parkhafen
Waltershofer Hafen

EFFORTS

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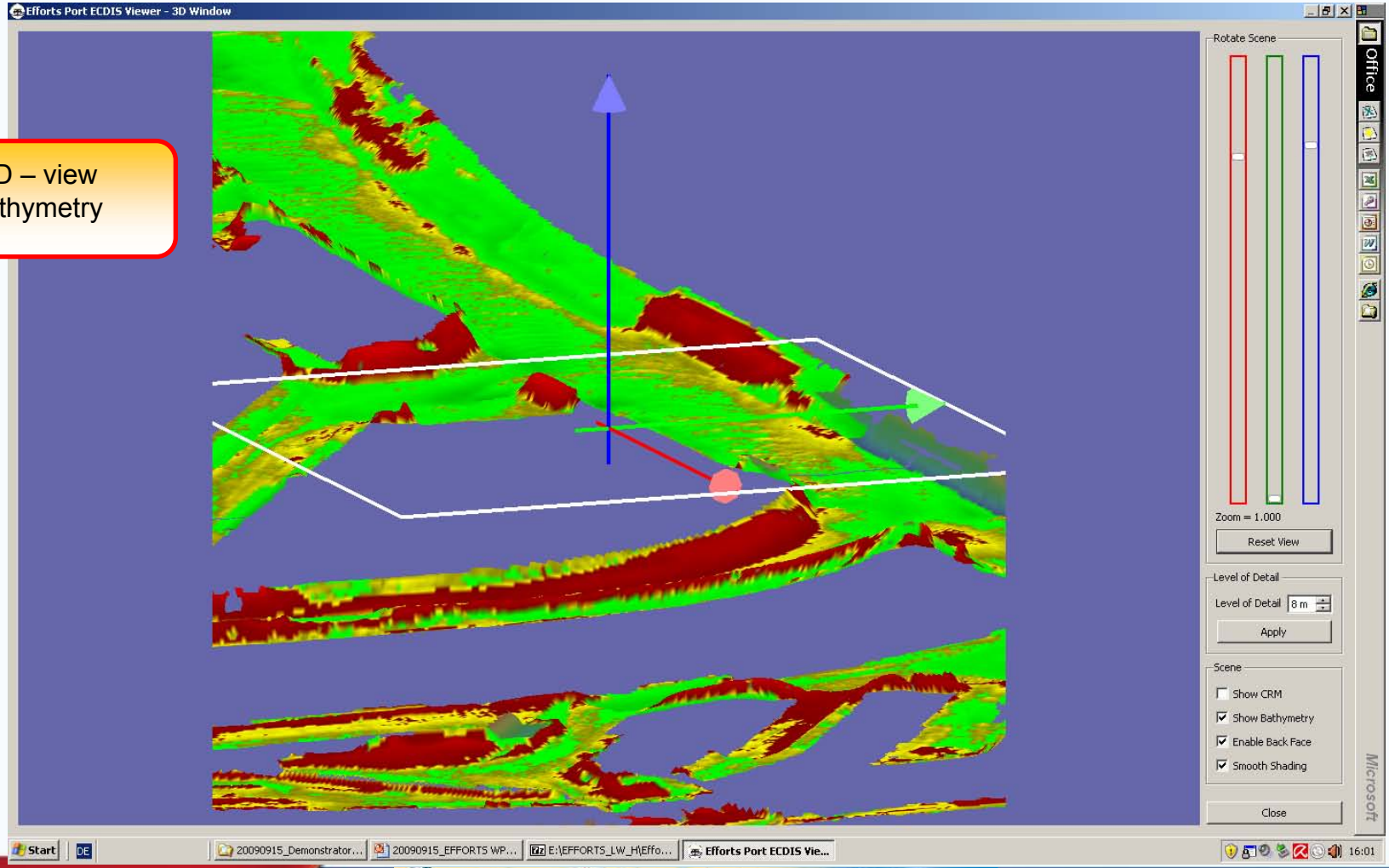
3 D – view
Bathymetry



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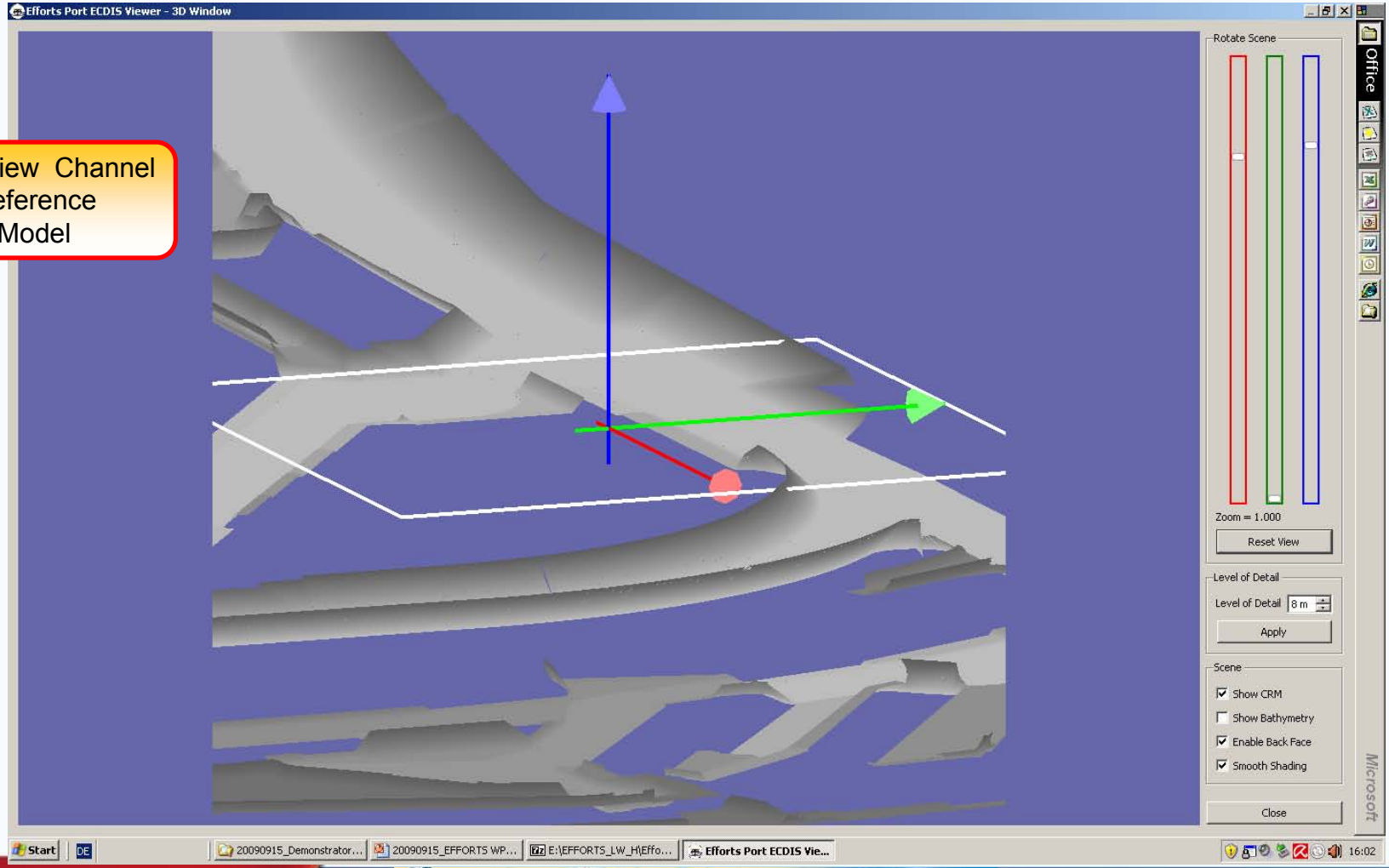
3 D – view Channel Reference Model



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3 D – view
Bathymetry versus
CRM

# Developing a Port ECDIS - a challenge mastered!!

## Final statement

It must be reliable and clear, that the harbour master, the pilot, the captain and all other user can trust the topographic and bathymetric information within the Port ENC!

So the Port ENC can be used as reference system for navigation!

**"If the vessel sails on land**
**the positioning of the vessel is inaccurate,**
**not the Port ENC!"**

# Developing a Port ECDIS - a challenge mastered!!

- Thank you for your attention!!

# Kontaktdaten

on behalf of the

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