**On behalf of the State of Israel – Ministry of Transport - Administration of Shipping and Ports, I am very pleased to welcome the distinguished delegates from all countries.**

**TOTEM Plus** will present today its innovative technology, which has been designed to assist the OOW in making correct decisions and hopefully to save seafarers' lives and prevent pollution of the marine environment.

An important novel aspect of this technology is the incorporation of AIS as a viable tool, which has not so far been addressed by IMO

**TOTEM PLUS** is an Israeli Company founded and managed by Capt. Azriel Rahav (Ph.D).

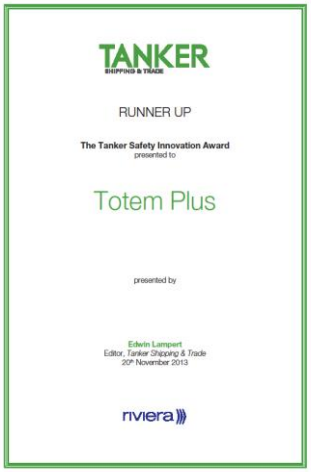
The System which is introduced today has been thoroughly tested and found effectively conforming to COLREGS in all aspects, and thus is approved by the Israeli Administration.

**Capt. Aleksander Gerson (MSc)**
**Deputy Director General**
**Director, Shipping and Ports Inspectorate**

The system is a winner of the following awards:

The PLIMSOLL Award for Innovation 2014
by the Maritime Reporter Stanford, Connecticut


The Tanker Safety Innovation Award,
Nov 2013, by Riviera Magazine, UK




5th Annual Safety At Sea
International Awards organized by HIS Fairplay
June 2011, London

# Speaker : Capt. Azriel Rahav, Ph.D
# CEO, "Totem Plus" Israel

1968 – Graduated Nautical College, Israel
1968 - 1978 Sailing as Deck Officer.
1978 – Certified as Master Mariner, FG
1979 – 1985 Command of Ocean Going ships.
1989 – Ph.D., Tel Aviv University (Physics).
1994 – Established Totem Plus (Marine Solutions)

# COLLISION AVOIDANCE DECISION SUPPORT SYSTEM

Marine Collisions Cost Lives and Cause Damage to the Environment

Is ARPA adequate?




Course and speed advice, Multiple vessels situations, *COLREGS*.

# Collisions cost lives & cause pollution

May. 5 2014: **11 missing**, “MOL Motivator” + “Zhong Xing 2 “ off HKG

Mar. 18 2014: **8 Casualties,** “Beagle 3” + “Pegasus Prime”, off Tokyo Bay

Aug. 17 2013: **120 Casualties,** “St. Thomas Aquinas” + “Sulpicio Express 7”, Cebu – Philippines.

Apr. 29 2013: **11 Casualties**, “CONSOUTH” + “PIRI REIS” south of Greece.

Apr. 25 2013: **6 Casualties ,** Trawler collided with Naval Ship off GOA.

Mar. 26 2013: “CMA CGM Florida” + “Chou Shan”, **610 tons heavy fuel leaked** into the water.

Dec. 5th, 2012 : **11 casualties** , “Corvus J” + “Baltic Ace” off Rotterdam.

*Partial List only - many more occurred during this period.*
*To the best of our knowledge, COLREGS* were not followed in all cases.

# The Problem

Collisions between ships have catastrophic results.

In last 12 months: 150 seamen **Lost their Lives**

More than 1000 Tons of Heavy Fuel were spilled

In most cases, COLREGS were not followed or were misinterpreted

ARPA has been with us for many years – but in too many cases **failed** in preventing collisions.

The Shipping Community should act to introduce New or Improved Technology to minimize the problem

# What is Required

A system that can assist the OOW in Decision making, DST, which should:

- Conform with COLREGS
- Suggest Safe Solutions, including situations of "Special Circumstances" as required by Rule 2
- Take advantage of all available data
- Be user friendly
- Be reliable

# Decision Support Tool - Specifications

DST should advise the OOW on exact course and/or speed changes required to Avoid Collision.

The OOW should be able to set certain key parameters (Range, CPA, TCPA).

The Master and/or Company are expected to set policy for other parameters, such as minimum distance to “give-way” vessels.

The system should be capable of accounting for all ships in vicinity, using both **AIS** and **ARPA**.

The “Decision Support Tool” should offer unambiguous advice in the presence of multiple targets, which **is not offered by ARPA**.

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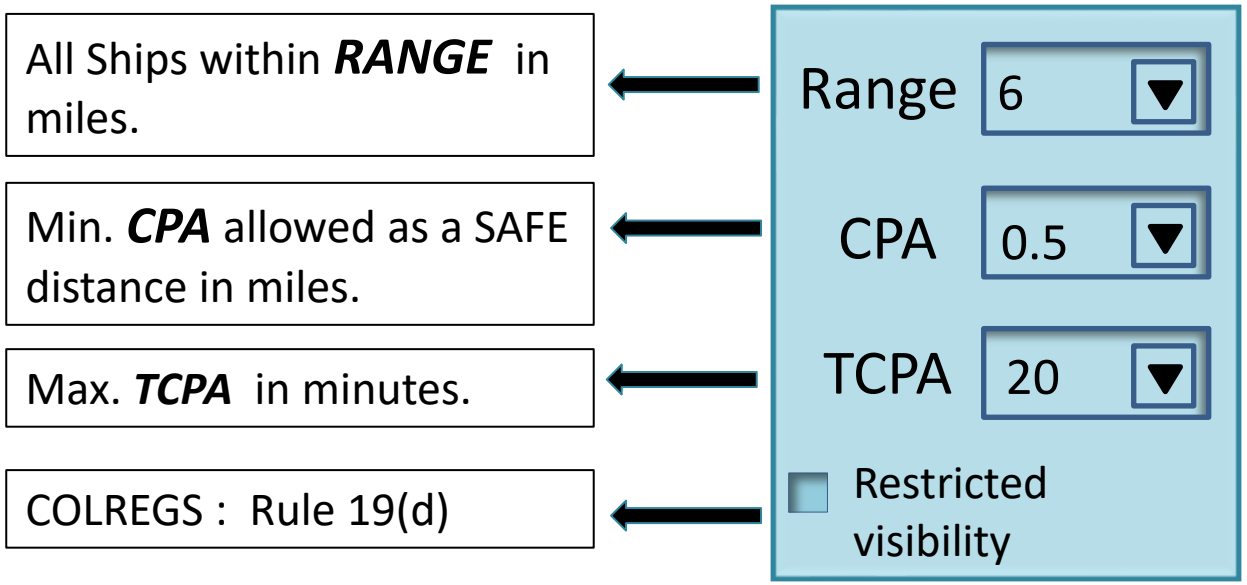
# DST : The Future is here.

- DST (Decision Support Tool) for Collision Avoidance was developed by **Totem Plus**.
- The System suggests a possible solution to the existing situation.
- The OOW is always in charge
- The New Technology was integrated into **Totem ECDIS**.
- DST is already **in use** on many ships.

# DST : Decision Principles

OOW selected parameters :




CPA : Closest Pont of Approach, in miles
TCPA: Time to CPA, in minutes.

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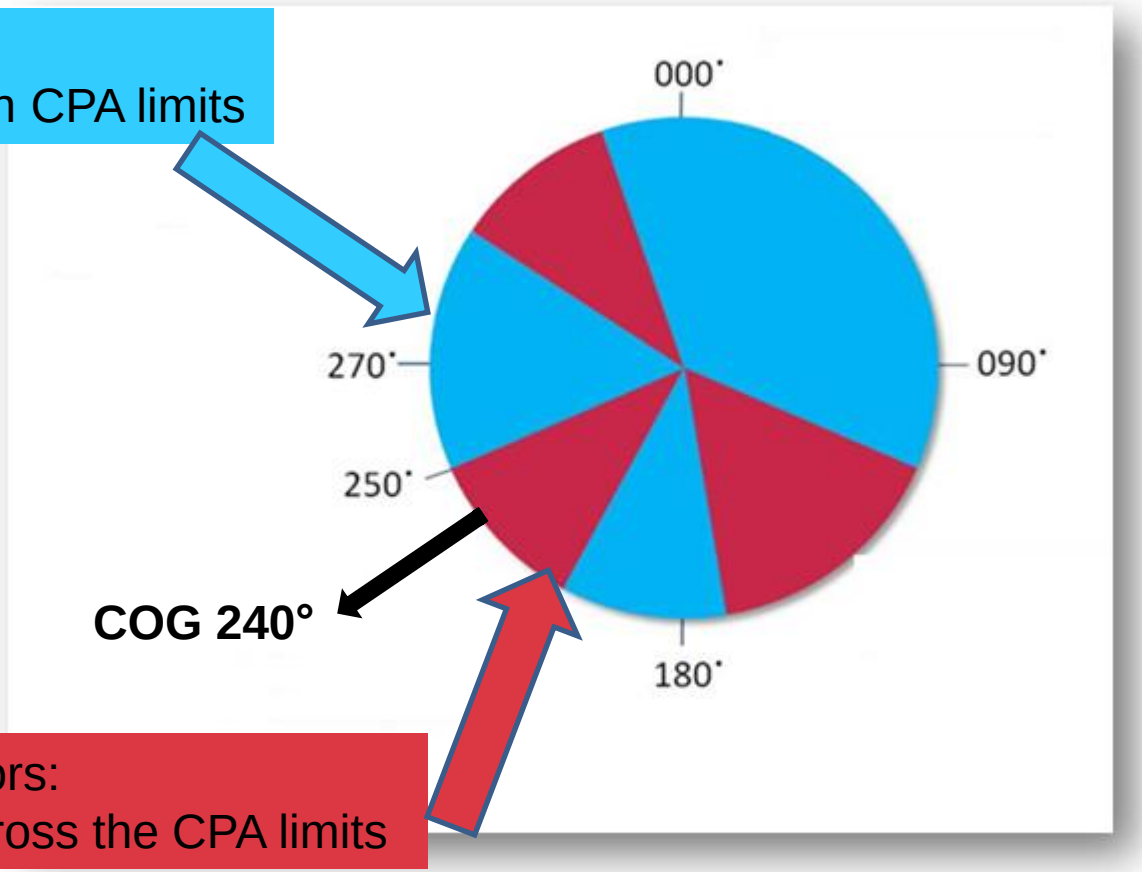
# The Navigation Circle : Possible courses

Safe Sectors: Courses
that keep the vessel within CPA limits



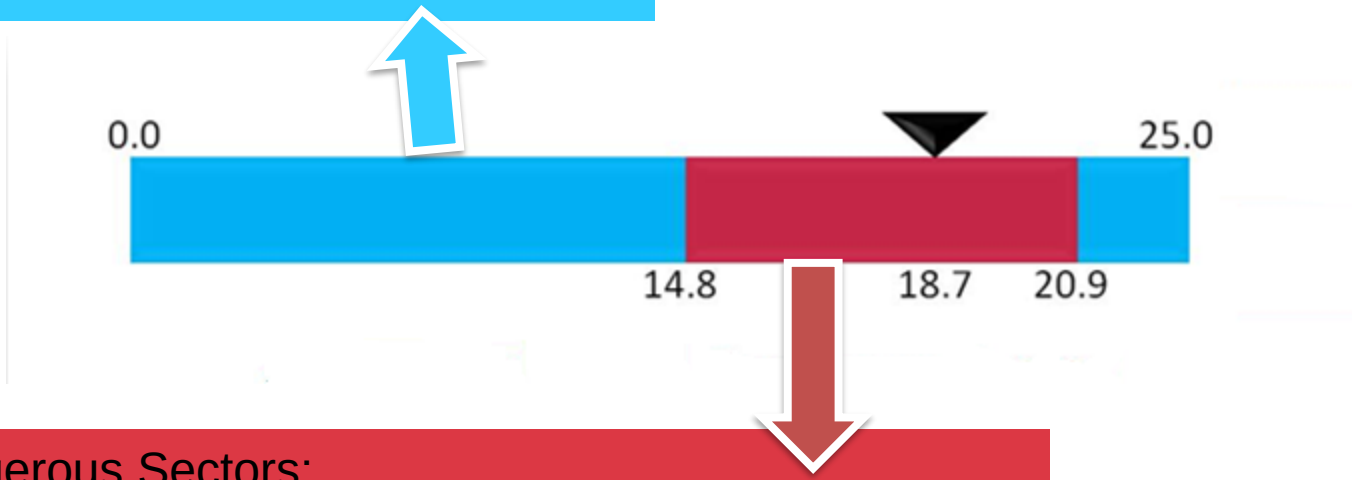

Dangerous Sectors:
Courses which cross the CPA limits

**Sectors are calculated automatically, based on CPA selection, for ALL targets within range.**
**Data from AIS and ARPA targets are utilized.**

# Speed Domain: Safe sectors

- **Calculated automatically, based on CPA selection**
- **Alternative option when course change is impractical.**
- **All target within range are considered, AIS and ARPA.**

Safe Sectors:
Speeds which keep the vessel within CPA limits




Dangerous Sectors:
Speeds which cross the CPA limits

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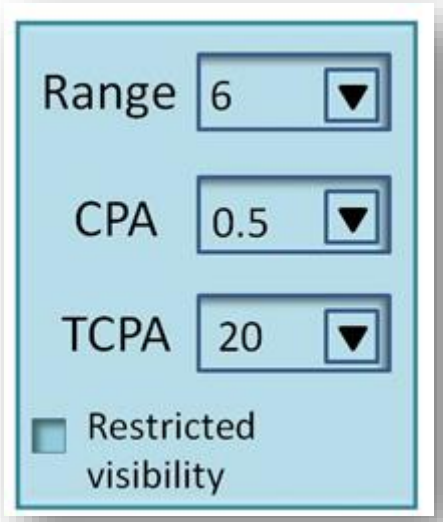
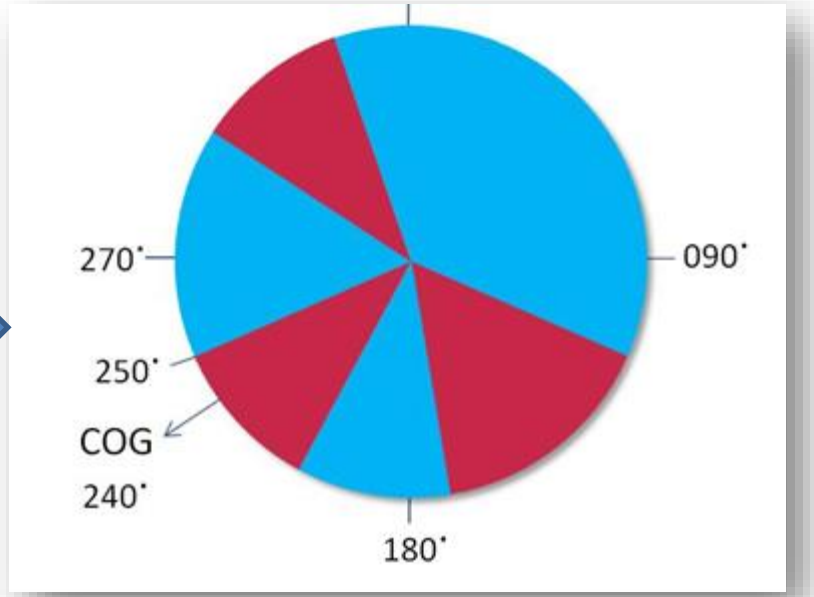
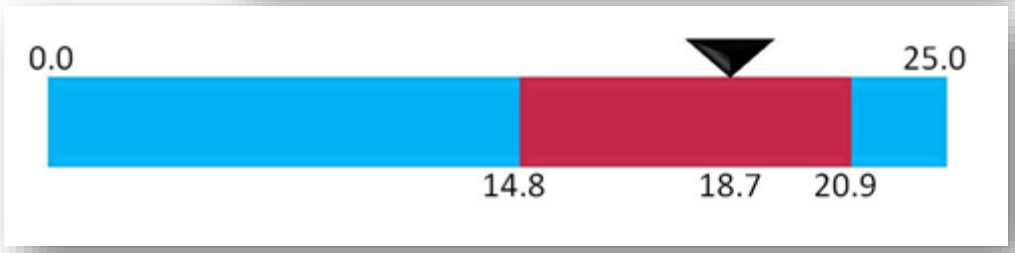
# The Full Picture

**Based on following parameters**




**Actual Situation**




**The advice is**

| | |
|---|---|
| 10° Starboard | Dec. Speed 14.8 Knots |
| New COG 250° | Inc. Speed 20.9 Knots |

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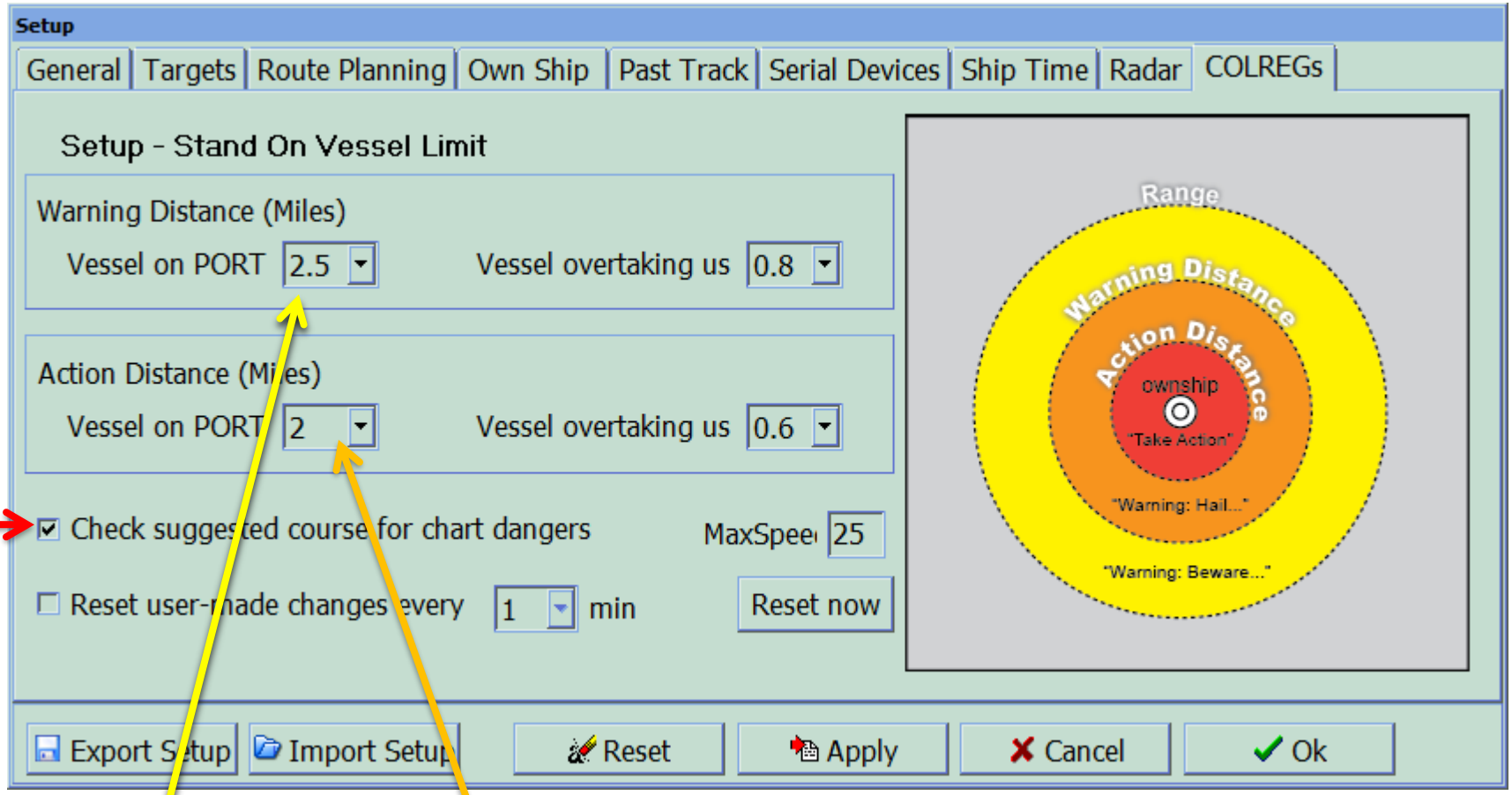
# Master/Company setup




1. Warning and Preventive Action distances to Give-Way vessels.

3. Check Course for Charted Dangers

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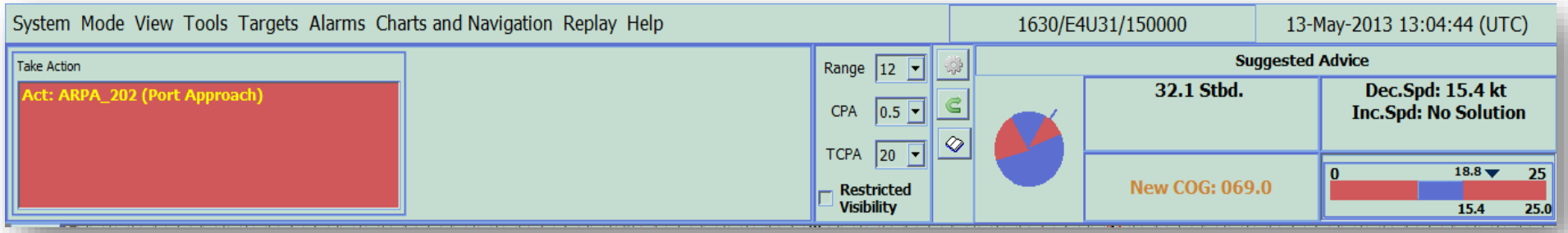
# OOW – set parameters, get advice




- OOW can set RANGE, CPA, TCPA.
- Dangerous and Safe sectors are shown (Red/Blue) .
- Advice is given – considering all ships, AIS and ARPA.
- Warning on “Give -Way” vessels.
- Restricted visibility – all ships are at “ST- ON” mode while “own-ship” is a “Give -Way” (Rule 19d)

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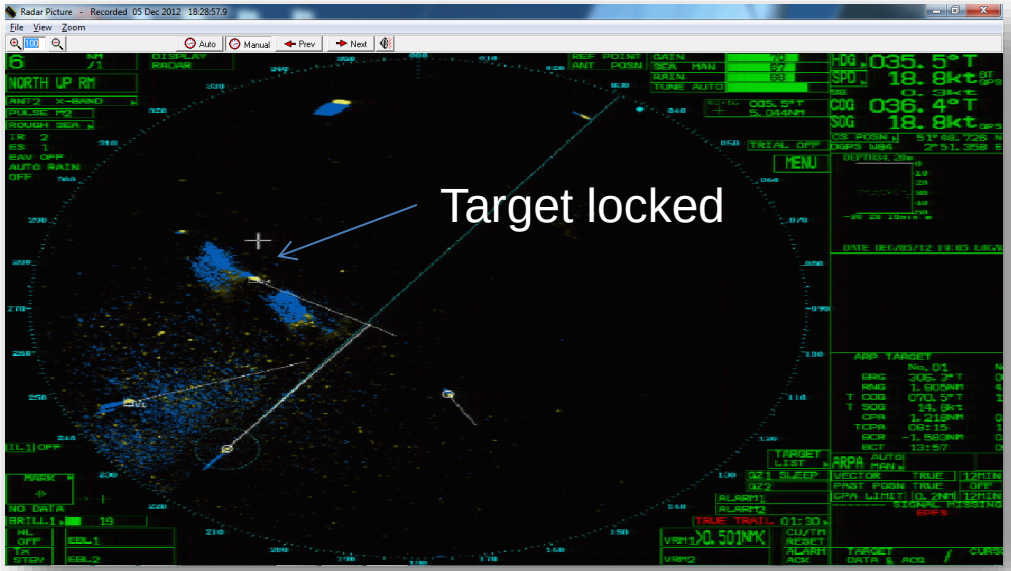
# Current technology :ARPA and AIS.





ARPA : Lock lost before collision


**Figure 13:** Sperry Visionmaster FT multiple target list

AIS MTS: “Not enough strategic info” (MAIB accident report, CMA CGM Florida)

# Movie time : Real Situation, North Sea

**Replay of ECDIS Data in Fast forward.**
**Shows the DST in operation, with more than 10 targets**.

North Sea crossing.

**(Replay : Superb tool for audits and performance monitoring).**

# Case Study 1: “Corvus J” – “Baltic Ace”

- Collision occurred on the night of Dec. 5th 2012
- Baltic Ace sank within 15 minutes, with **11 casualties**
- Location - West of Rotterdam, in rough weather.

***Source**: free data available on the internet.*

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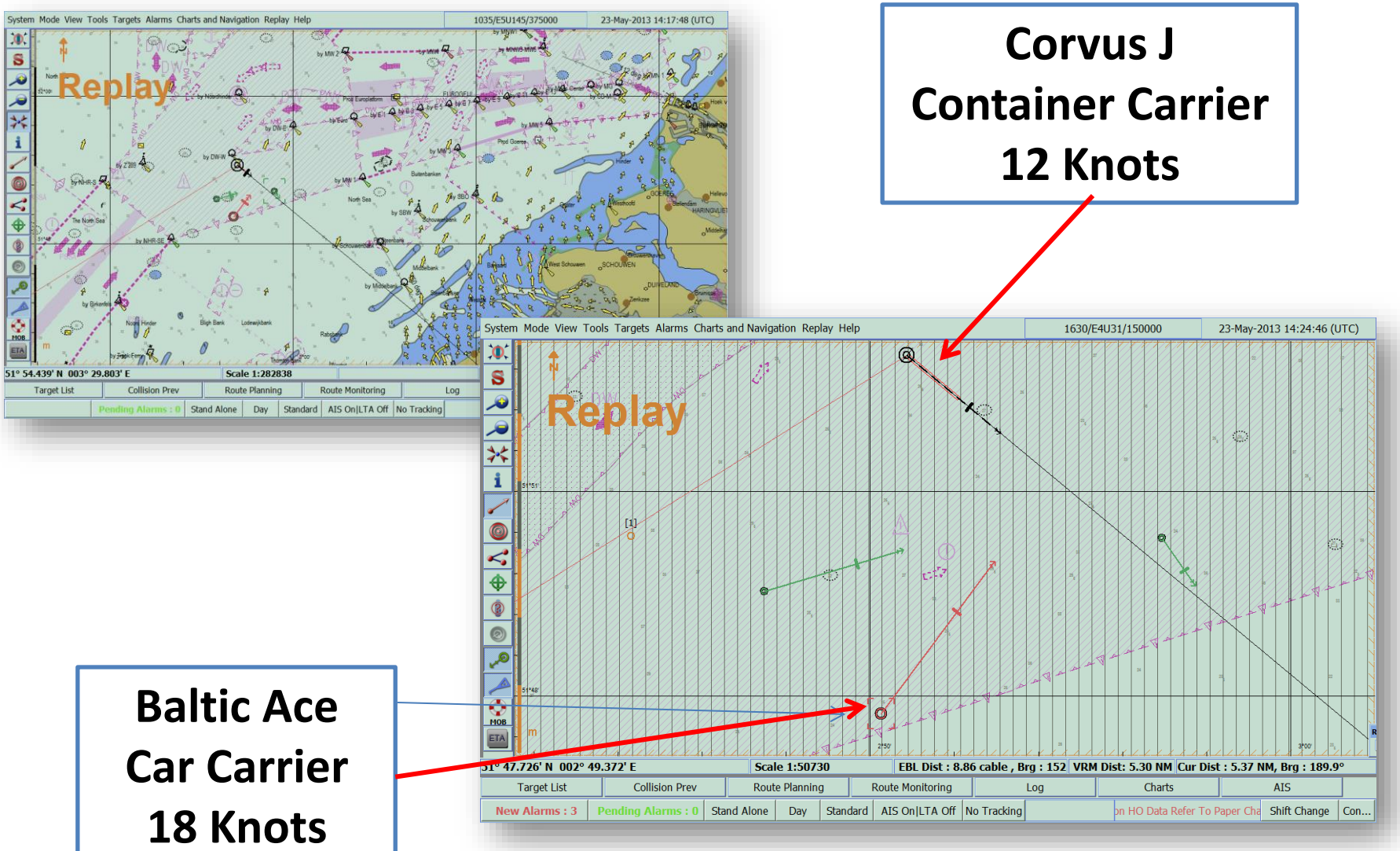
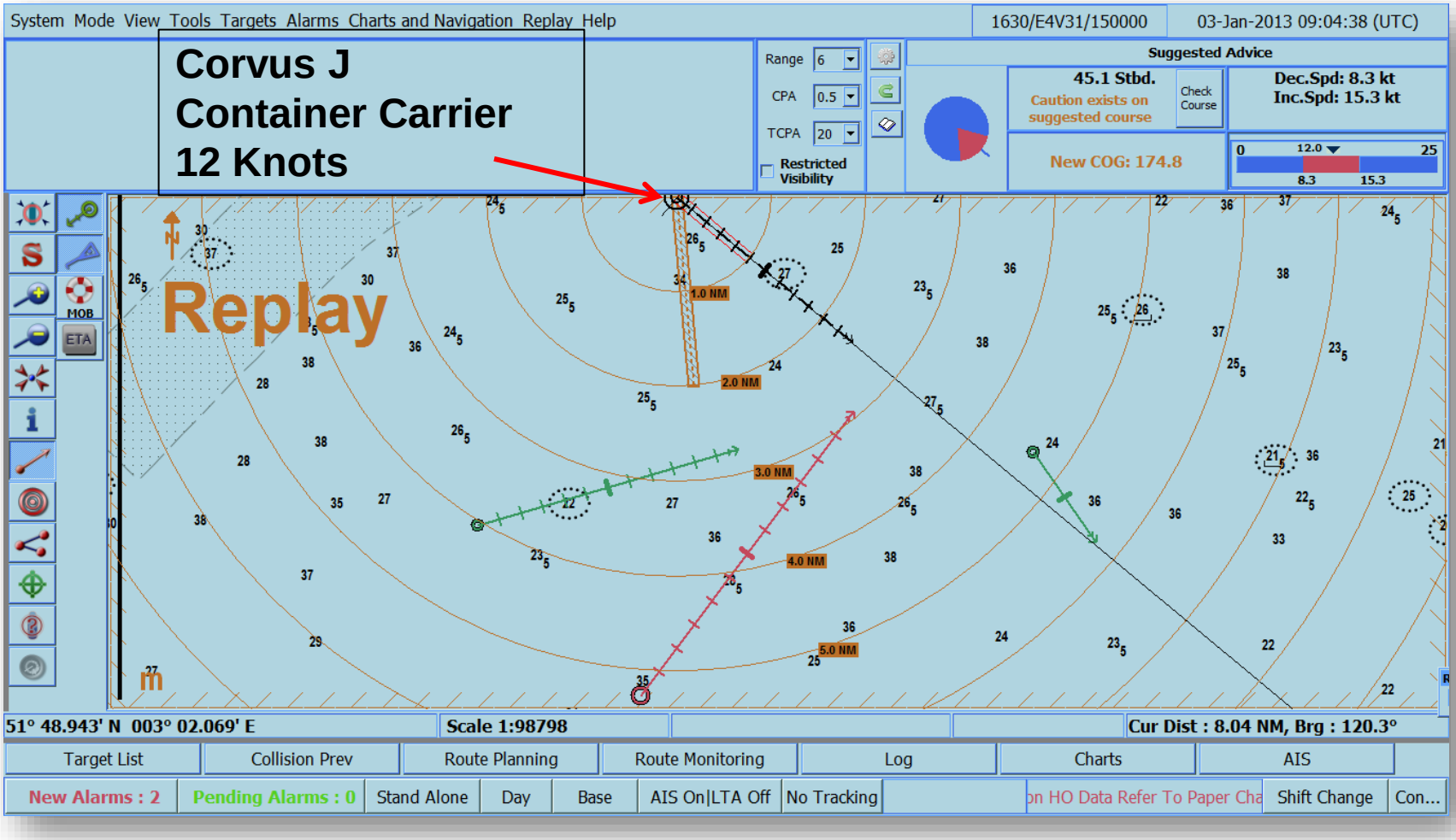
# The initial situation : Crossing



# The “Give-Way”: “Corvus J”




**Advice to Corvus J : Turn 45 to Starboard, or reduce to 8.3 Knots**

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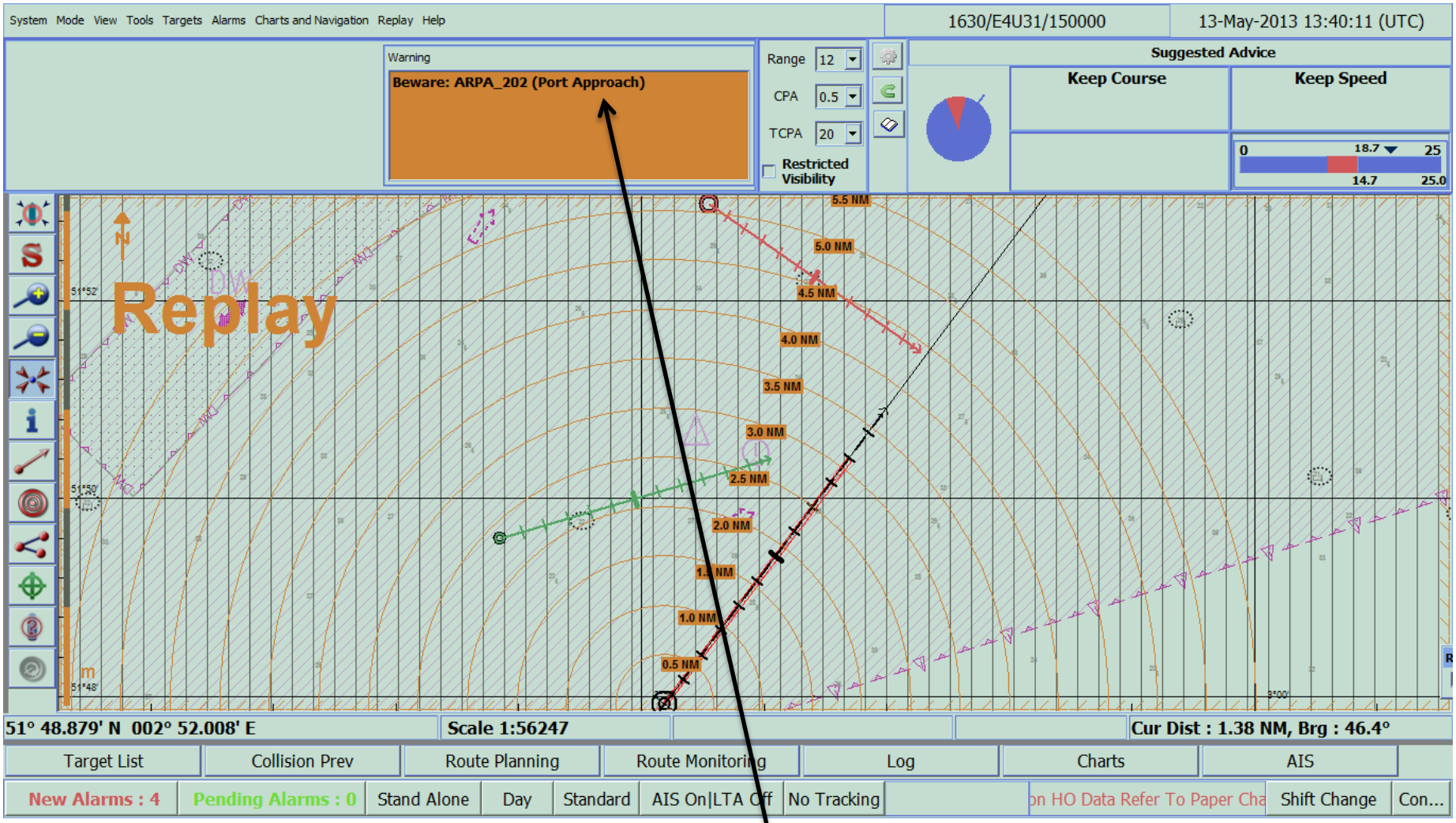
# The “Stand-on”: Baltic Ace




**Advice : Keep Course and Speed - but BEWARE on Port!**

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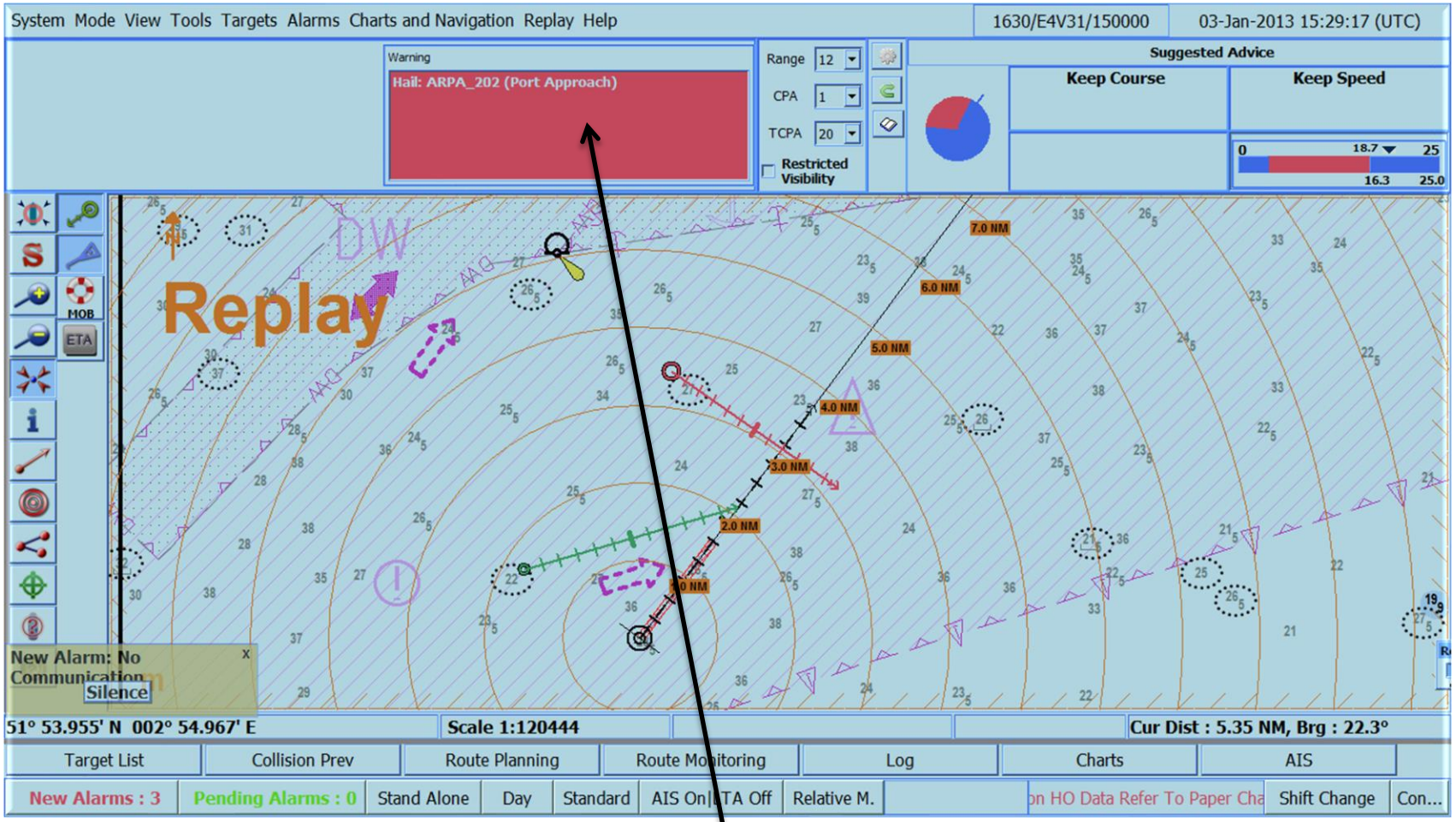
# In Doubt? Blow the Whistle!!




The Give-Way vessel does not act – HAIL for intentions!!!

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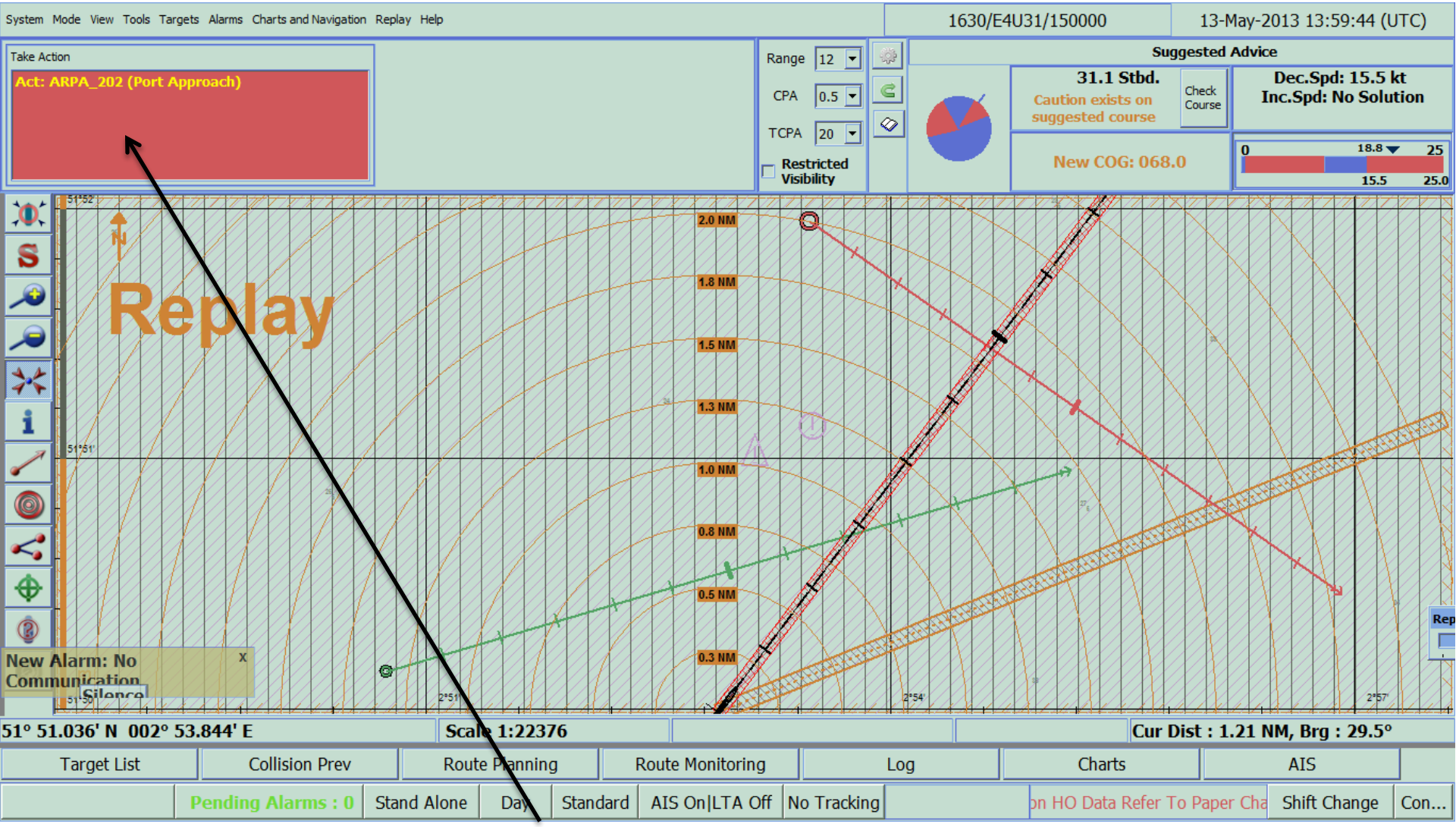
# Action by “Stand-on” Vessel




If the Give-Way vessel does not act it is St. On vessel DUTY to avoid collision. STBD.

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# Collision.

- Baltic Ace turned to Port
- Corvus J turned to Starboard
- The use of Decision Support could have prevented the collision

# Case Study 2:
# "MSC Prestige" – "Samco Europe"

- Collision occurred on the night of Dec. 7th 2007

- The Super Tanker "Samco Europe" collided with the Container Ship "MSC Prestige" in Gulf of Aden, in clear weather.

- No Injuries but **50M USD** claims for damages to both ships.


*Source: Report of Safety Investigation, Bureau d'Enquêtes sur les Événements de Mer (French Marine Accident Investigation Office).*

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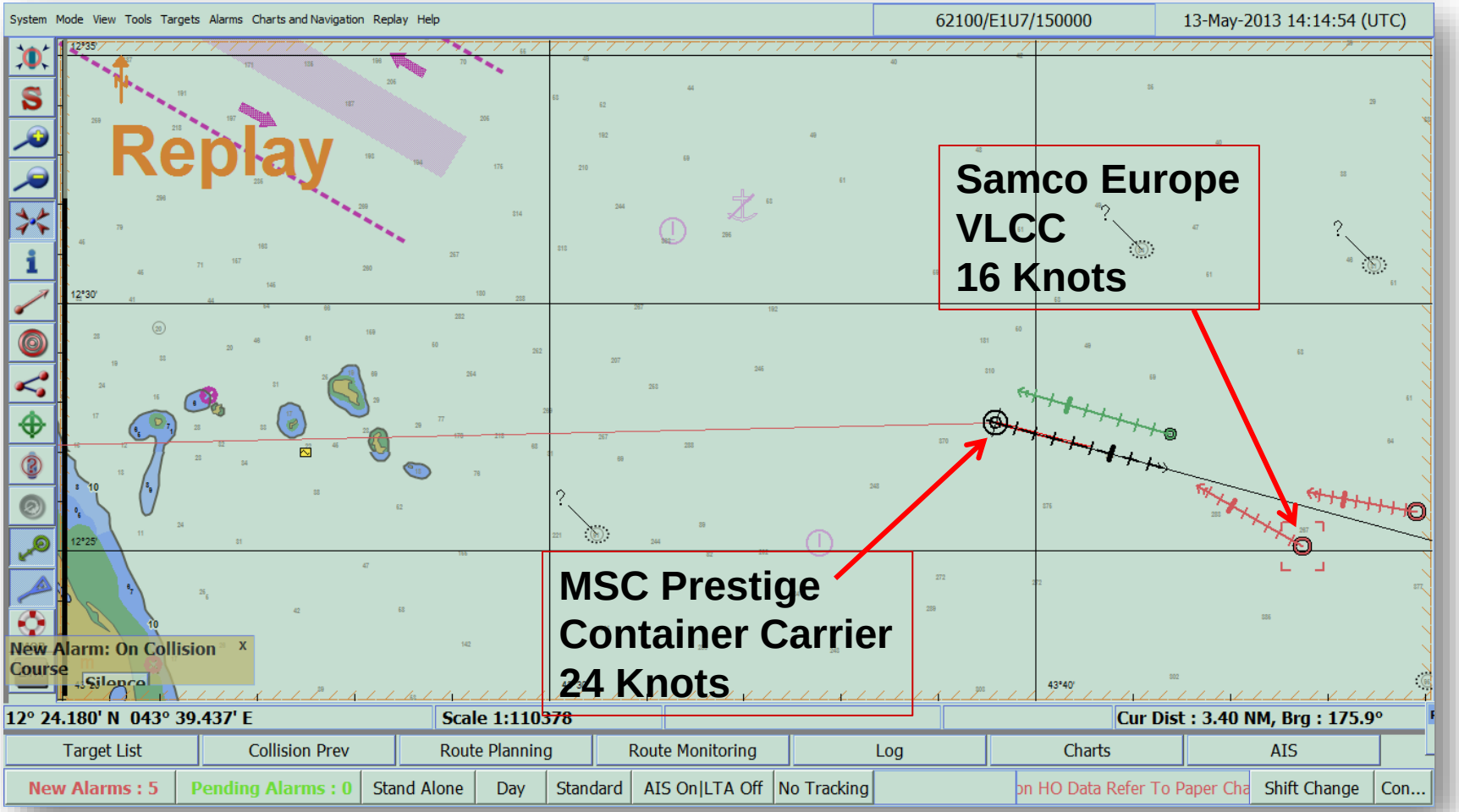
# Normal Situation : Traffic Convergence

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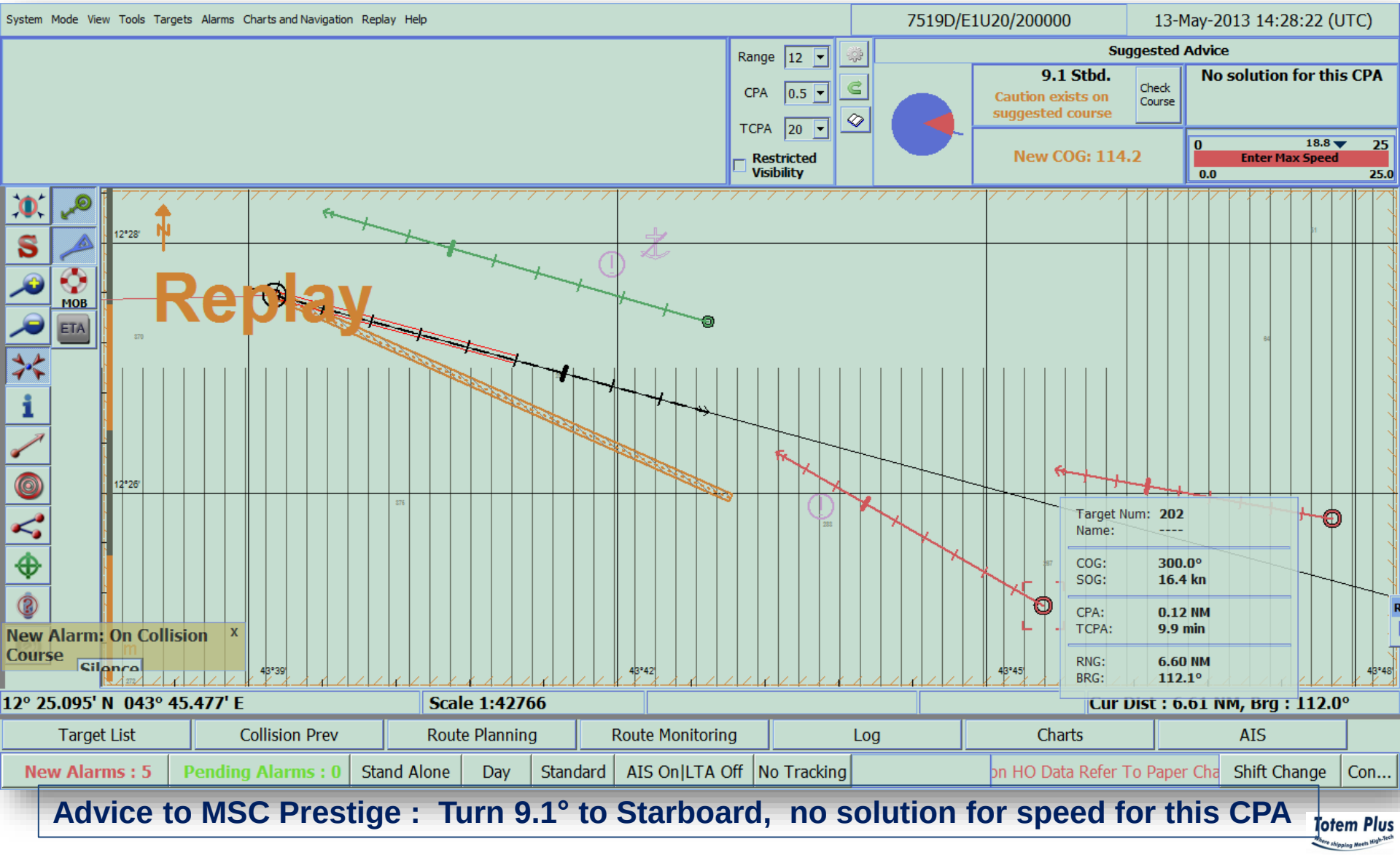
# The “Give-Way” ship: MSC Prestige




**Advice to MSC Prestige : Turn 9.1° to Starboard, no solution for speed for this CPA**

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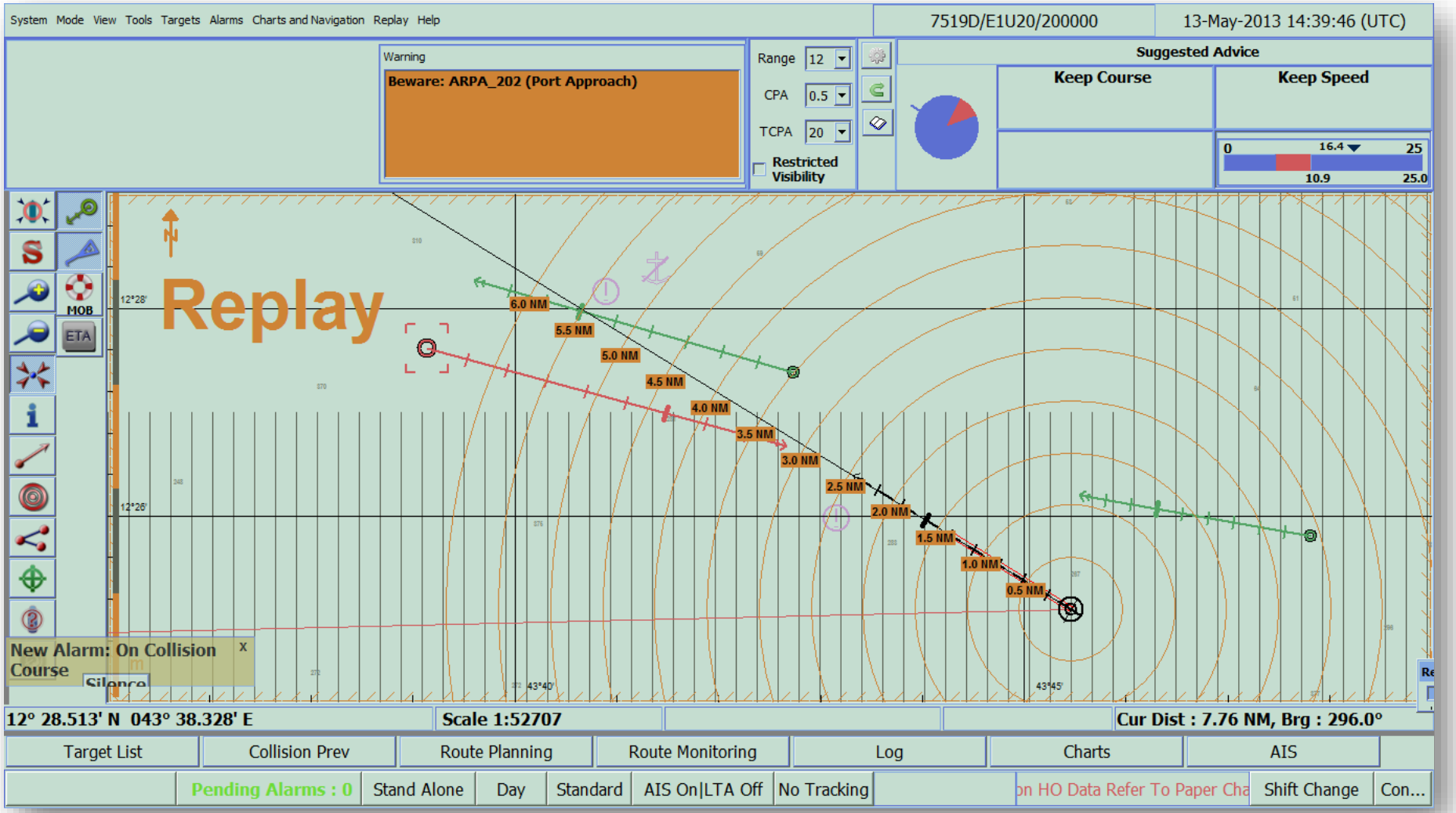
# The Stand on : “Samco Europe”




**Advice to Samco Europe: Keep Course, Keep Speed but beware on port**

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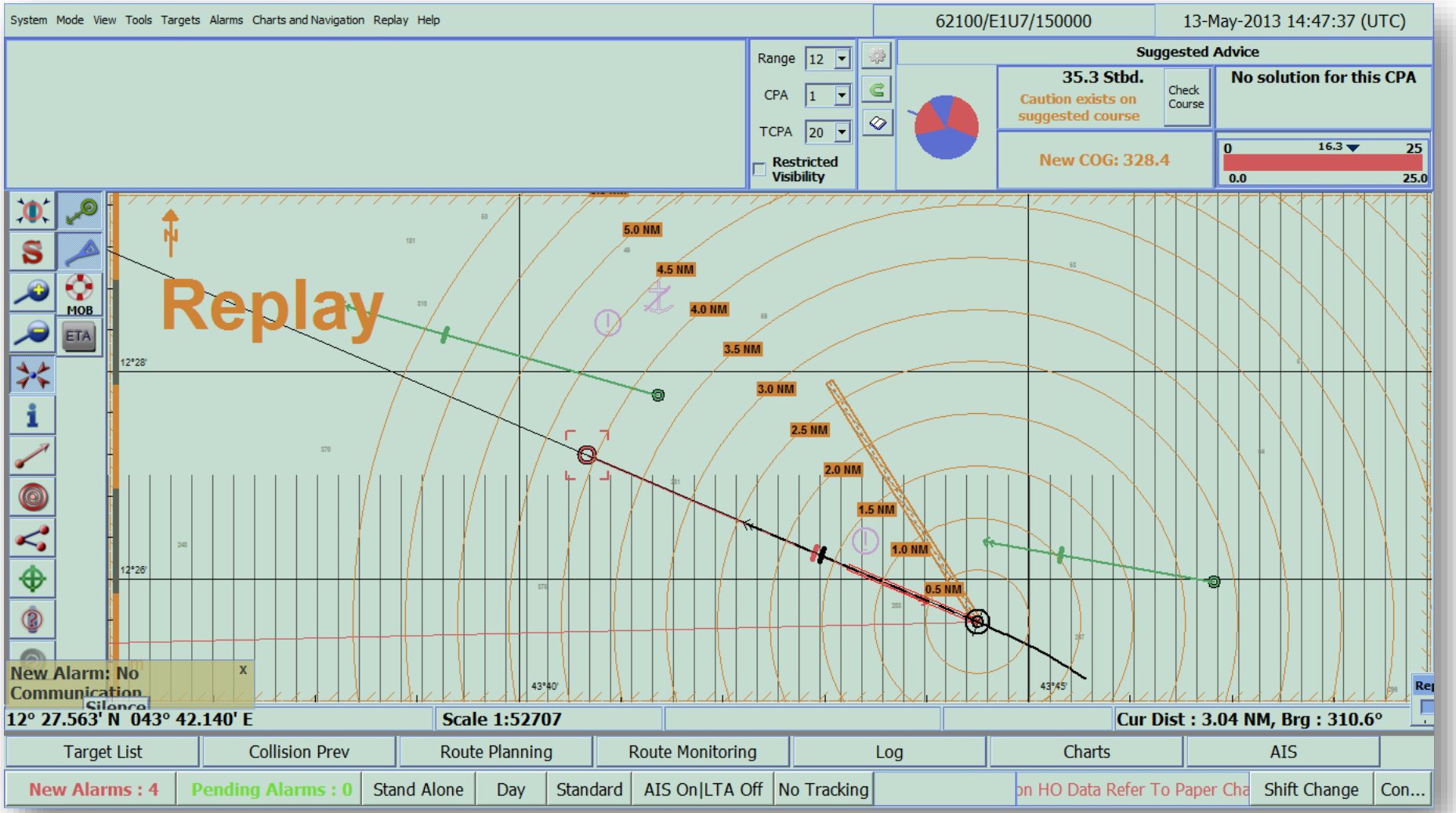
# “Samco Europe” – Head-On situation




**Advice to Samco Europe: Turn 35.3° to Starboard, no speed solution for this CPA,**
**Note: caution on suggested course**

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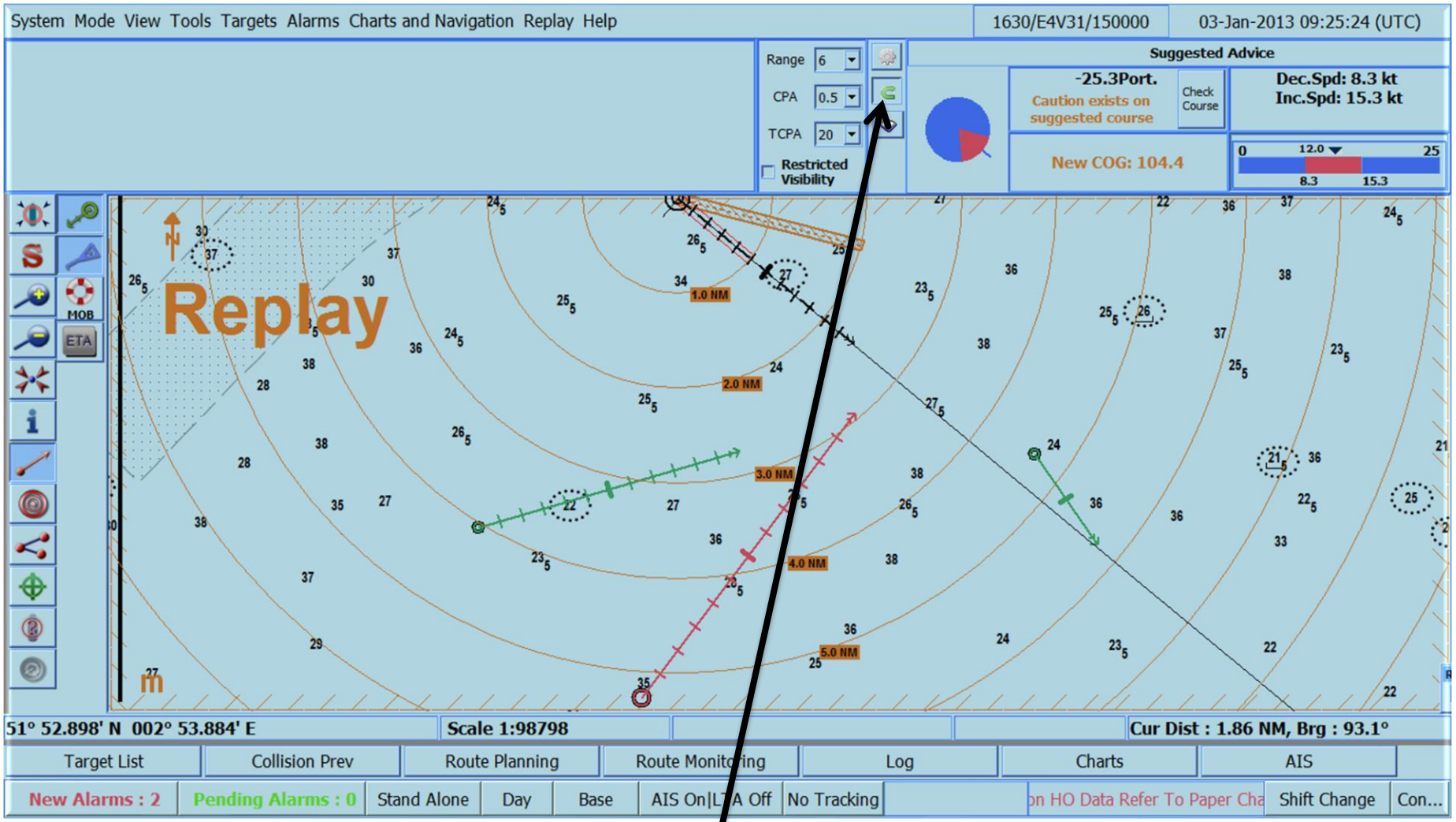
# Collision (2).

- Samco Europe turned to Port
- MSC Prestige  turned to Starboard
- Use of Decision Support could have prevented the collision.

# Other Options

| | |
|---|---|
| Is there an option for the OOW to explore a turn to the other side (to Port)? | Yes |
| Is advice offered in poor visibility? | Yes |
| Is there full data for every ship? | Yes |
| Is a full target list available? | Yes |

# Possible Alternative: Turn to Port!?




Alternative – if stb'd not safe - press test button

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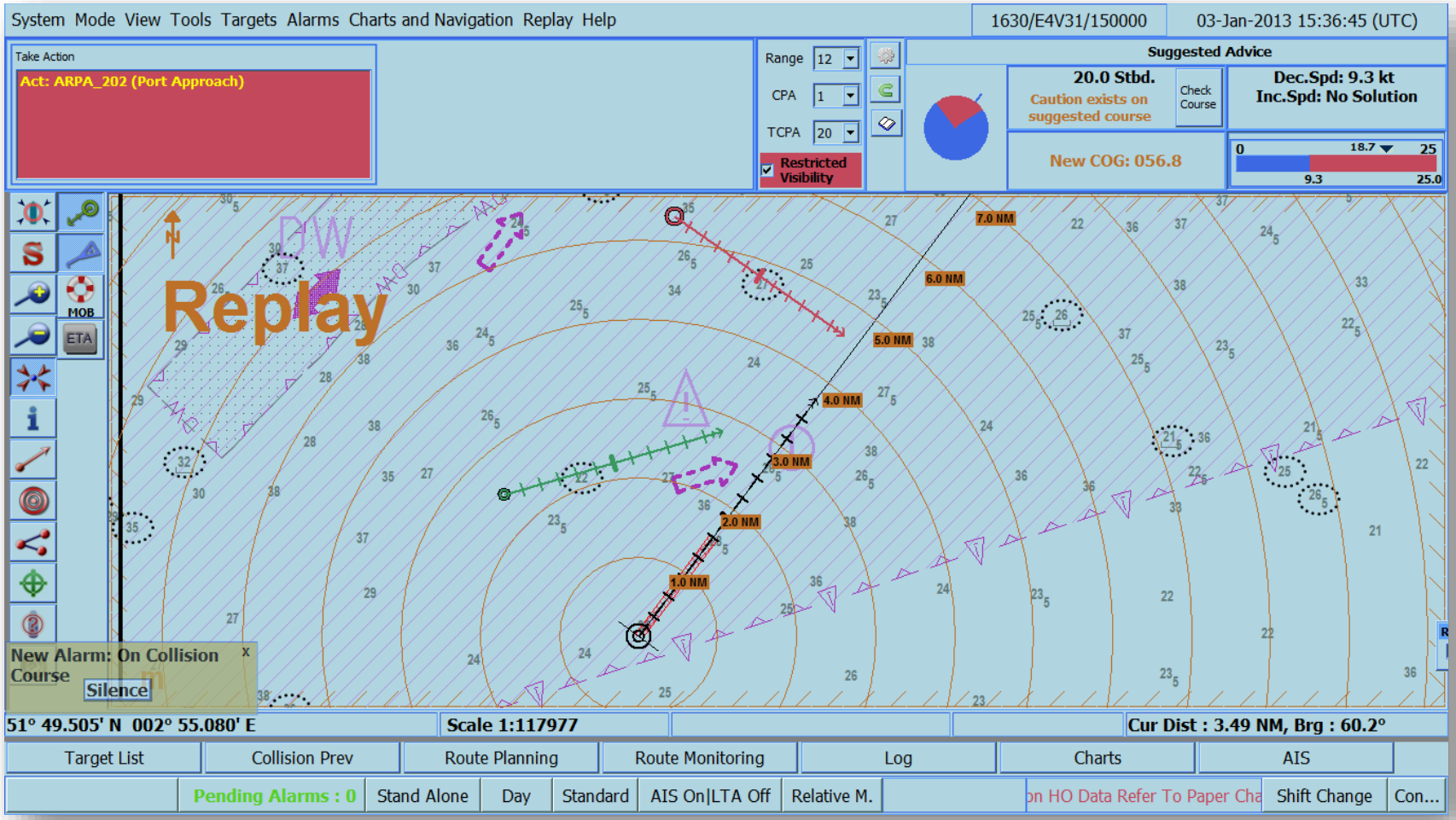
# Restricted Visibility: Take Avoiding Action (19d)




Never turn towards a Target Crossing from Port!!

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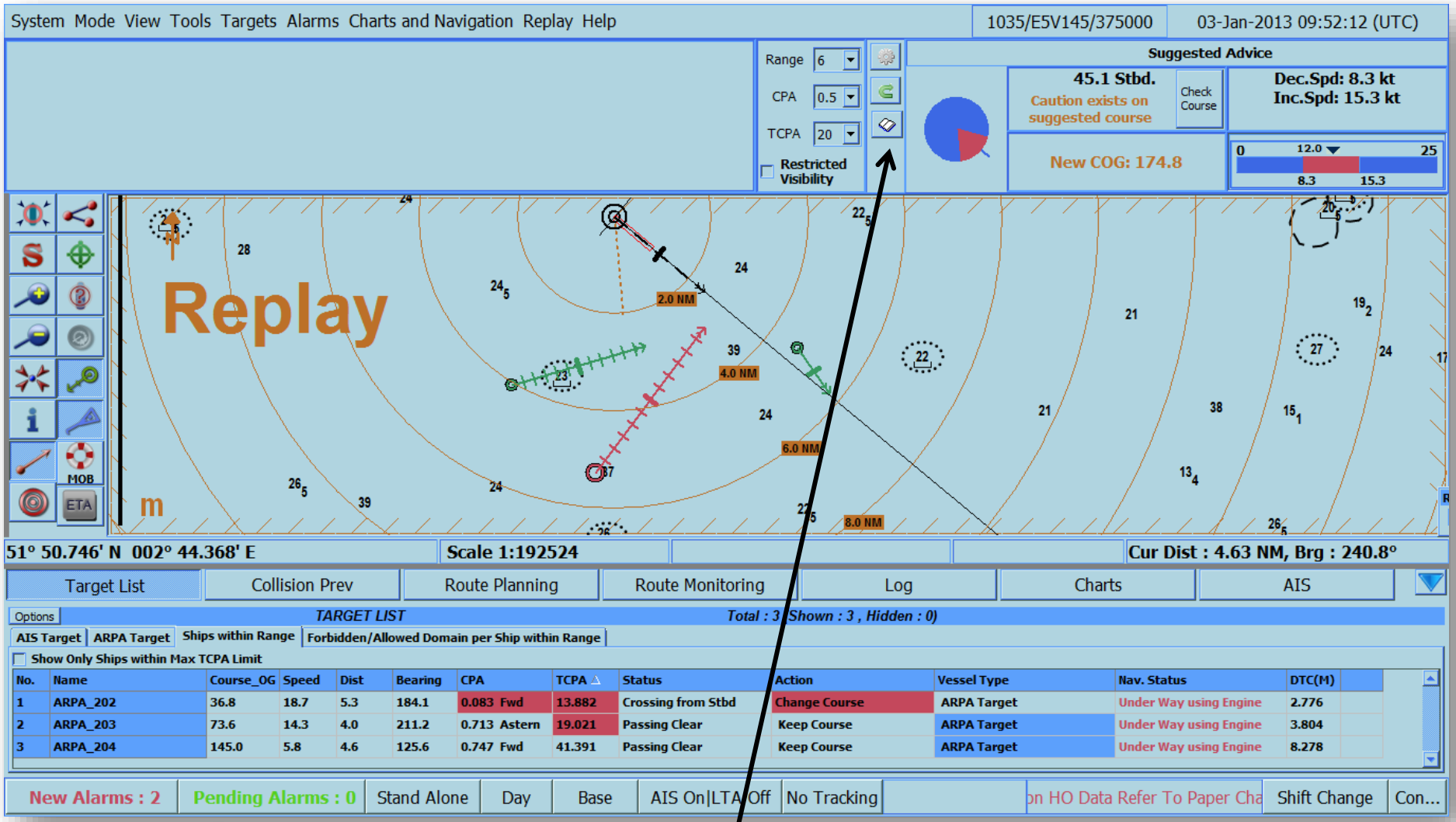
# Full data of all relevant targets




Click the lower button for Target List!

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# DST Target Lists

AIS Target | ARPA Target | Ships within Range | Forbidden/Allowed Domain per Ship within Range

☐ Show Only Ships within Max TCPA Limit

| No. | Name | Course_OG | Speed | Dist | Bearing | CPA | TCPA | Status | Action | Vessel Type | Nav. Status | DTC(M) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ARPA_302 | 165.0 | 13.0 | 4.3 | 279.7 | 0.641 Fwd | 12.593 | Crossing from Stbd | Change Course | ARPA Target | Under Way using Engine | 3.568 |
| 2 | SHIP33 | 164.3 | 12.6 | 4.3 | 280.1 | 0.539 Fwd | 12.616 | Crossing from Stbd | Change Course | Unknown Type (199) | UNDef | 3.575 |
| 3 | SHIP34 | 9.7 | 10.0 | 5.2 | 219.2 | 0.736 Astern | 13.092 | Crossing from Port | Keep Course | Unknown Type (199) | UNDef | 3.710 |
| 4 | SHIP37 | 58.7 | 10.6 | 9.7 | 234.5 | 1.708 Astern | 20.773 | Passing Clear | Keep Course | Unknown Type (201) | UNDef | 5.886 |
| 5 | SHIP39 | 353.6 | 11.5 | 10.8 | 212.5 | 1.269 Astern | 27.980 | Passing Clear | Keep Course | Unknown Type (201) | UNDef | 7.928 |
| 6 | SHIP36 | 230.0 | 17.5 | 3.0 | 356.2 | 1.095 Astern | 29.619 | Passing Clear | Keep Course | Unknown Type (200) | UNDef | 8.392 |
| 7 | ARPA_303 | 230.0 | 18.0 | 3.0 | 355.4 | 0.819 Astern | 29.825 | Crossing from Stbd | Change Course | ARPA Target | Under Way using Engine | 8.450 |
| 8 | SHIP35 | 245.9 | 9.4 | 3.9 | 241.5 | 0.684 Astern | 30.325 | Overtaken by us | Change Course | Unknown Type (200) | UNDef | 8.592 |

## Ships Within Range: as per setup (12M range, 1M CPA, 20 Min TCPA)

- All targets are shown and updated, regardless of ARPA setup.
- Shown clearly: CPA ahead/Astern, *COLREGS* Status.
- AIS info – Vessel Type and Nav. Status.
- Ability to change Nav. Status of Vessels.
- DTC

AIS Target | ARPA Target | Forbidden/Allowed Domain per Ship within Range

☑ Show Only Ships within Max TCPA Limit

| No. | Name | Course_OG | Speed | Dist | Bearing | CPA | TCPA | Status | Action | Vessel Type | Nav. Status | DTC(M) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SHIP33 | 164.0 | 13.0 | 4.4 | 280.3 | 0.592 Fwd | 12.756 | Crossing from Stbd | Change Course | Unknown Type (199) | Under Way using Engine | 3.614 |
| 2 | SHIP34 | 10.2 | 10.1 | 5.4 | 219.4 | 0.737 Astern | 13.322 | Crossing from Port | Keep Course | Unknown Type (199) | Under Way using Engine | 3.775 |

***Filter – show only targets within TCPA***

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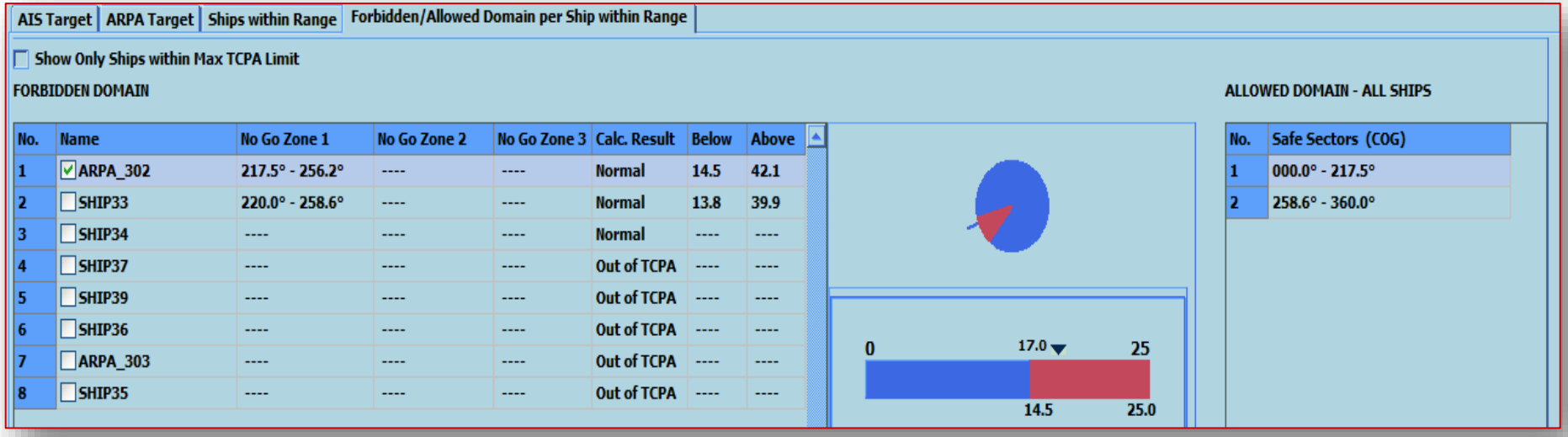
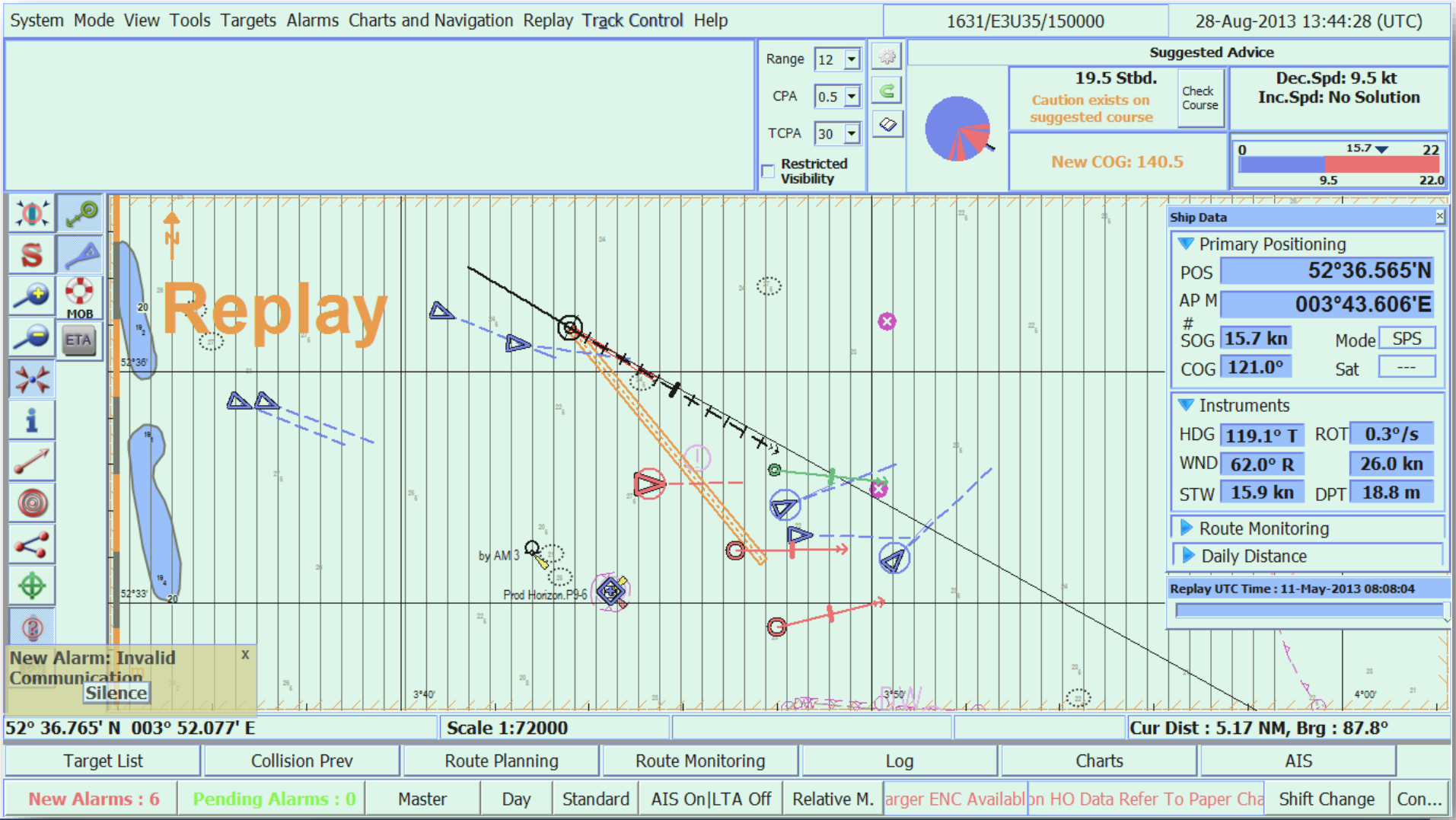
# More info available

For each target within range, we can also see the boundaries of safe sectors and real-time speed advice for each vessel.



# CONCLUSIONS: DST Prime Goal




One of the important innovations of the DST is the inclusion of AIS data, an issue which has not been so far properly addressed.

# Summary

- Totem Plus has developed the DST.
- DST was tested for over 4 years, on many vessels, and received 3 international awards.
- Feedback from users is positive and shows that the advice is accurate and useful in traffic analysis.
- Training is essential for proper and effective use.
- The shipping community can seize the opportunity and adopt the principles of this technology to save lives and protect the environment.
- The DST may be considered as harbinger of E-Navigation.

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# Thank You for your time and patience