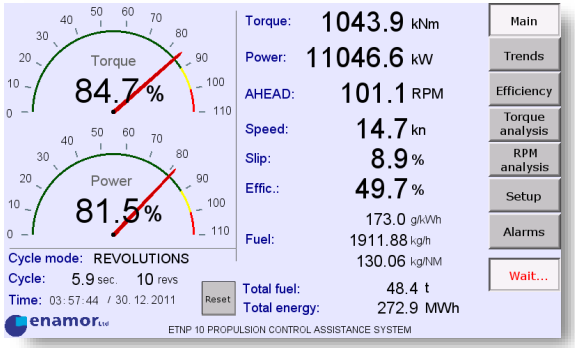
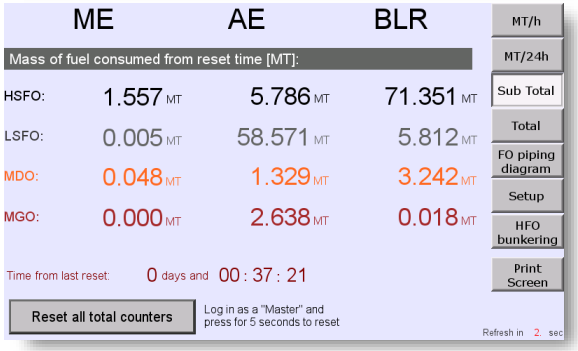
ETNP-10

Propulsion Control Assistance System



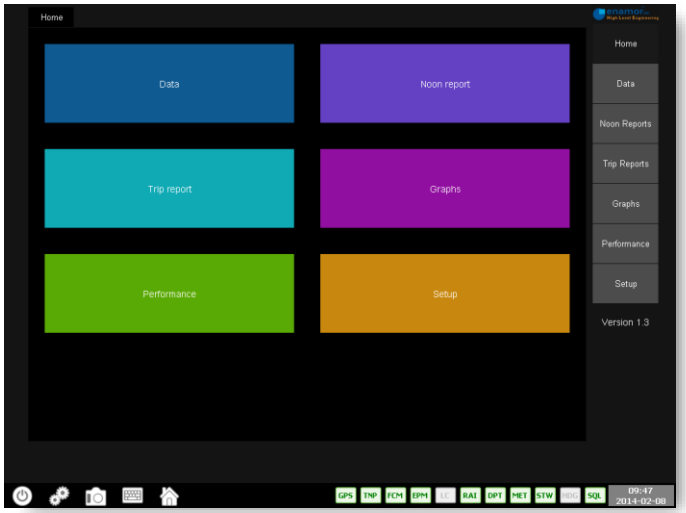
EFCM

Fuel Consumption Monitor



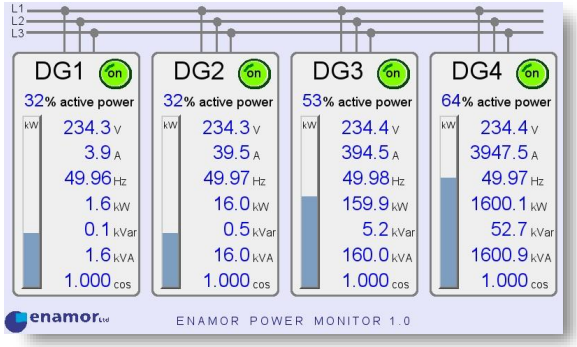
EPM

Enamor Power Monitor



ESOS 2.0

Ship Efficiency Optimisation and Integration System



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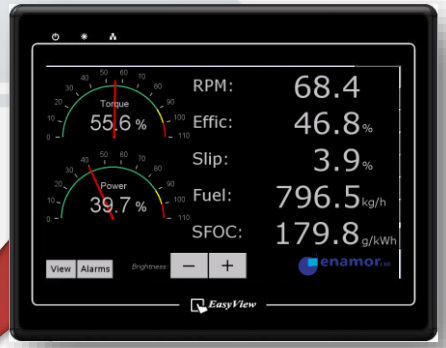
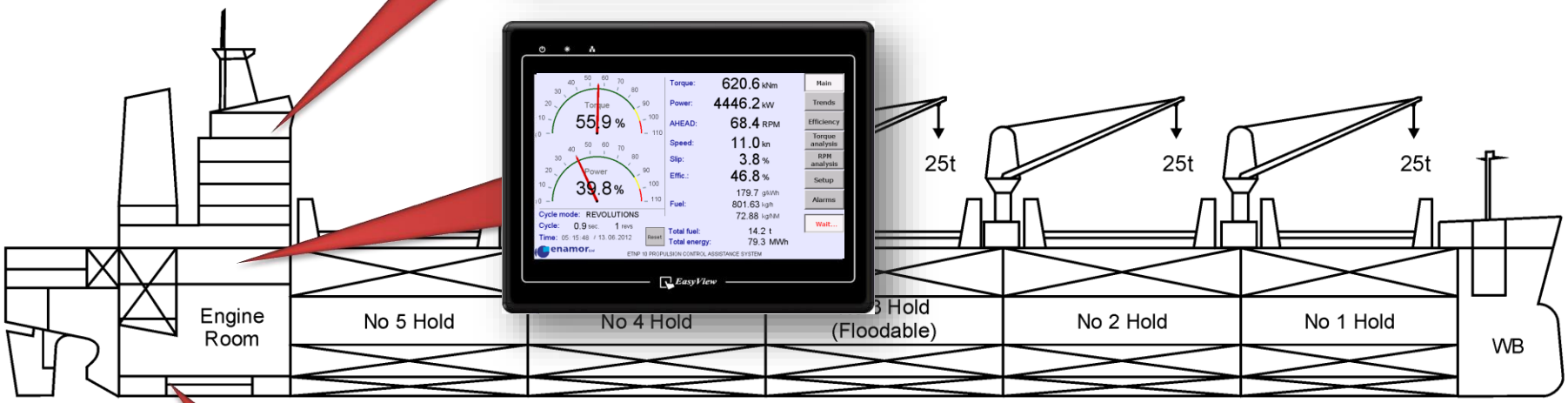
ETNP-10 System



ETNP-10 is dedicated tool for measuring and data logging information about ship propulsion.



Advantages:

- Provides ME overload protection
- Helps in economical exploitation onboard
- Long term exploitation factors control
- Makes easier to avoid non-routine propulsion maintenance and repair

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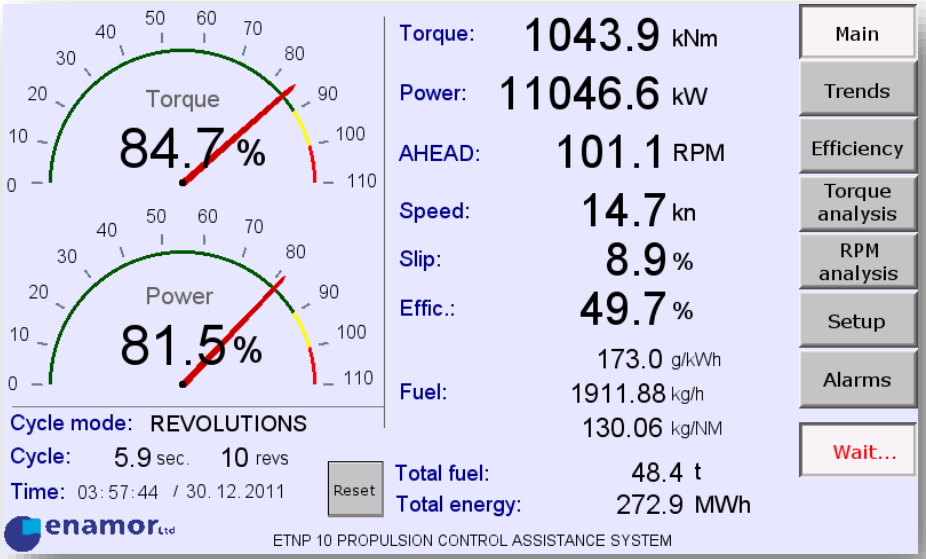
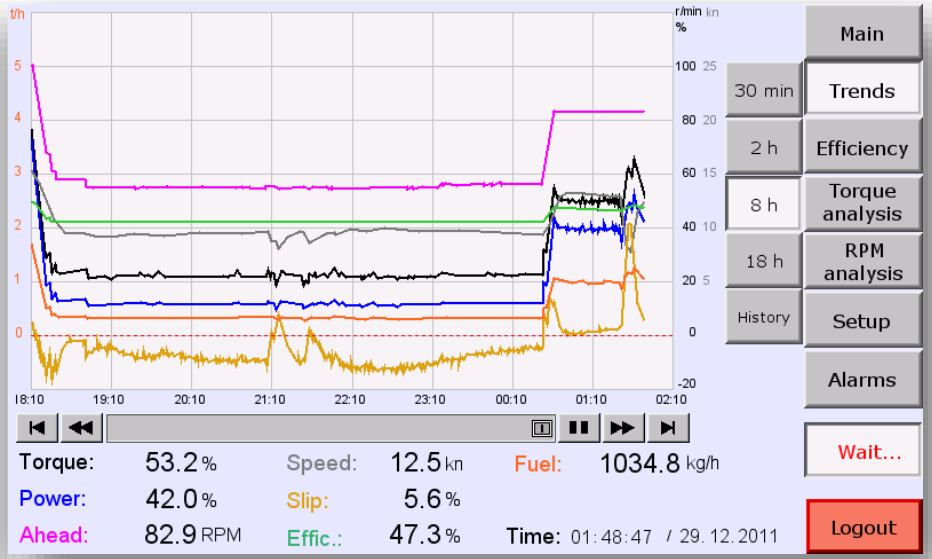
Main and Trends screens in ECR



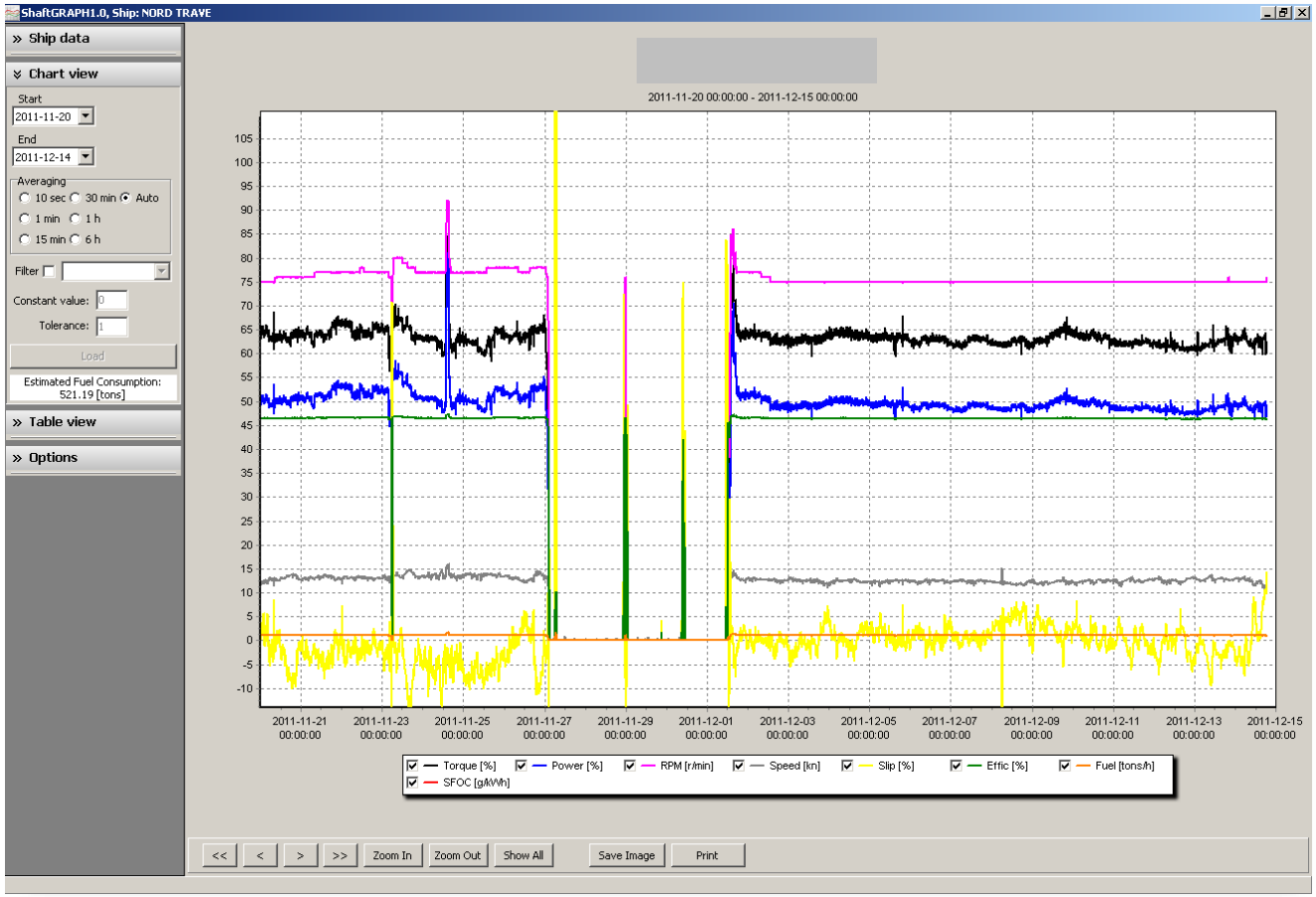


Main features:

- **Accuracy** - optical measuring head and fast microchip
- **Stability** - stable measurement in long-term period
- **Reliability** - long work without malfunctions
- **Simplicity** - ergonomic and easy to use touch panel visualization
- **Heavy-duty** construction
- **Short installation** time
- **Easy to integrate** with other systems (NMEA output)
- **Calibration on turning gear** – sea trials are not required

Office software: ShaftGRAPH

- Decoding .dtl files
- Vessels comparison
- Long term analysis on charts
- Table view
- Averaging samples
- Printing (printer, PDF)
- Save image (JPG, BMP)



ShaftGRAPH.lnk

Economy of Exploitation

- Worth to try:
  - change vessel trim/draught and online observe shaft power or fuel consumption and speed
  - check results of using trim optimizer (trim by bow, trim by aft) i.e. ECO-Assistant
  - compare mean shaft power before and after hull cleaning/ME parameters settings
  - adjust autopilot settings (max rudder angle) etc.

Each condition change is seen on shaft power!

Economy of exploitation

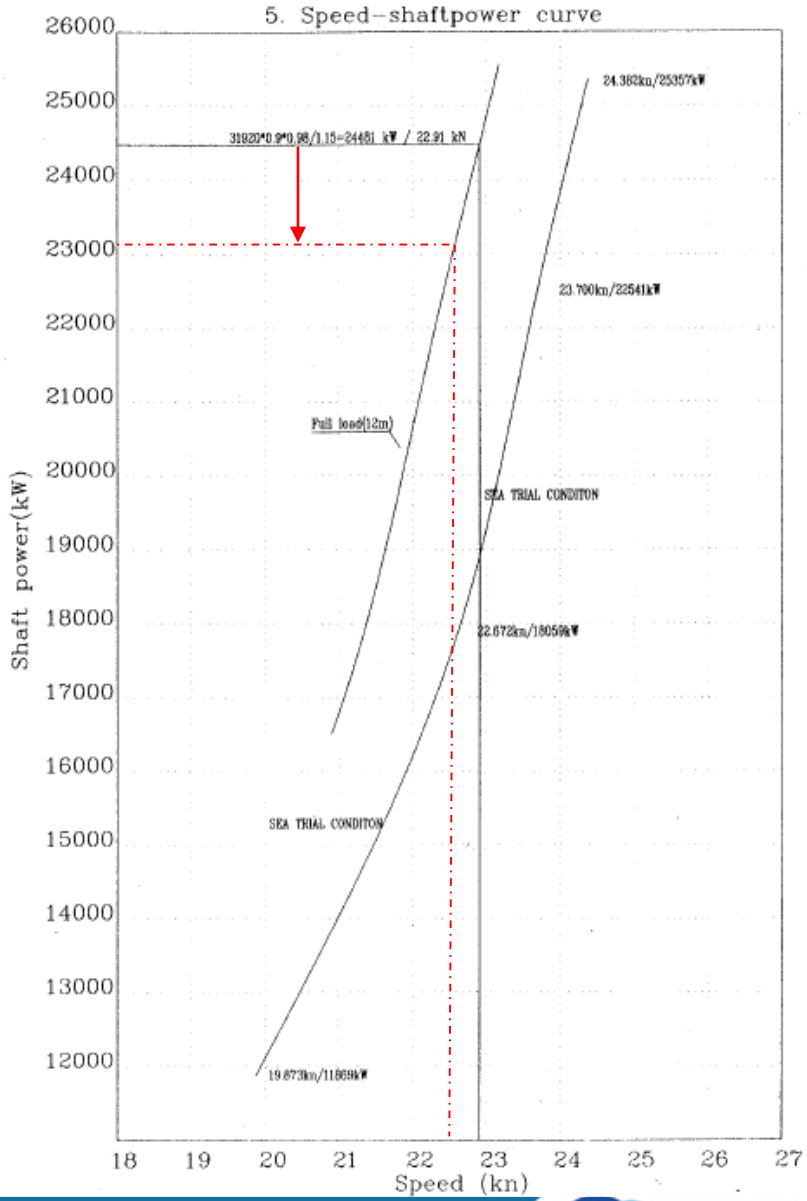
Example:

<u>Lower speed vessel 22.6 kn → 22.3 kn:</u>

24500 kW – 23000 kW = 1500 kW

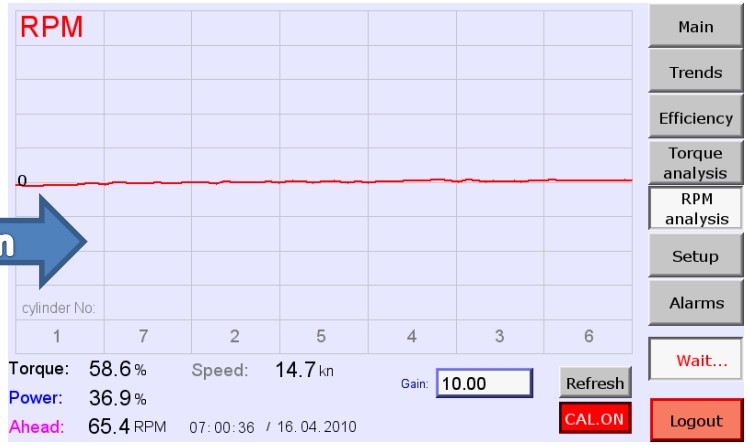
1500 kW x 178 g/kWh = 0,267 t/h

0,267 t/h x 24 h = 6,4 t/day



Preliminary ME diagnostic

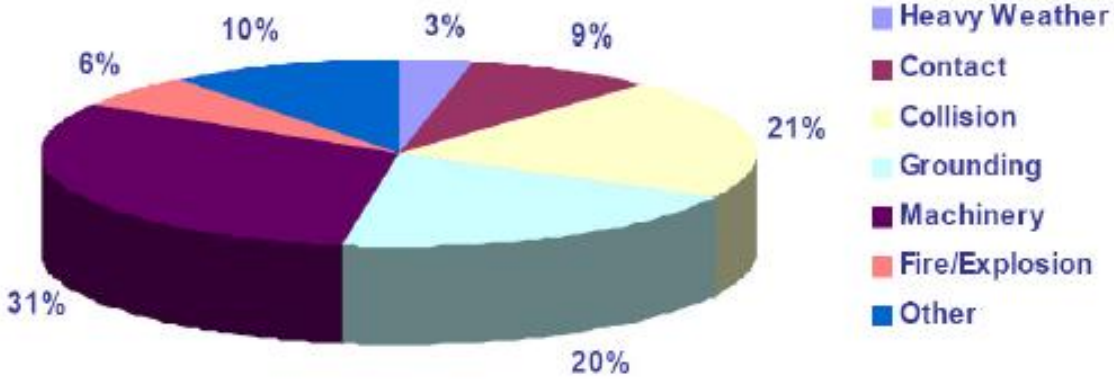
Calibration



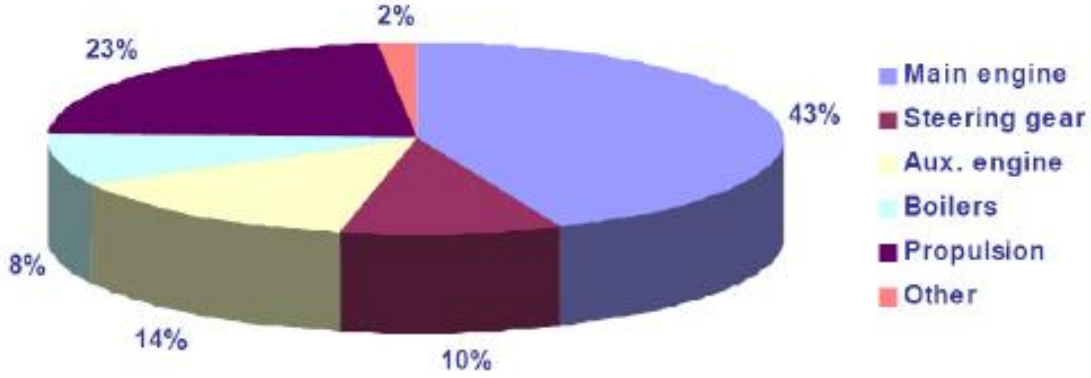
Fuel oil on cylinder No **7** cut off

- Shaft torsional vibration (non-uniformity control):
  - RPM
  - Torque
- Identifying flat cylinder earlier

Failure Statistics in Shipping acc. Insurance Companies



a) Failure Statistics for 1996-2006



b) (Machinery claims by cost 1998-2004)

Analysis of ship shaft line coupling bolts failure
Dr hab. inż. Czesław Dymarski, prof. nadzw. PG. Politechnika Gdańska, Wydział Oceanotechniki i Okrętownictwa
Mgr inż. Marek Narewski Polski Rejestr Statków SA

Summary

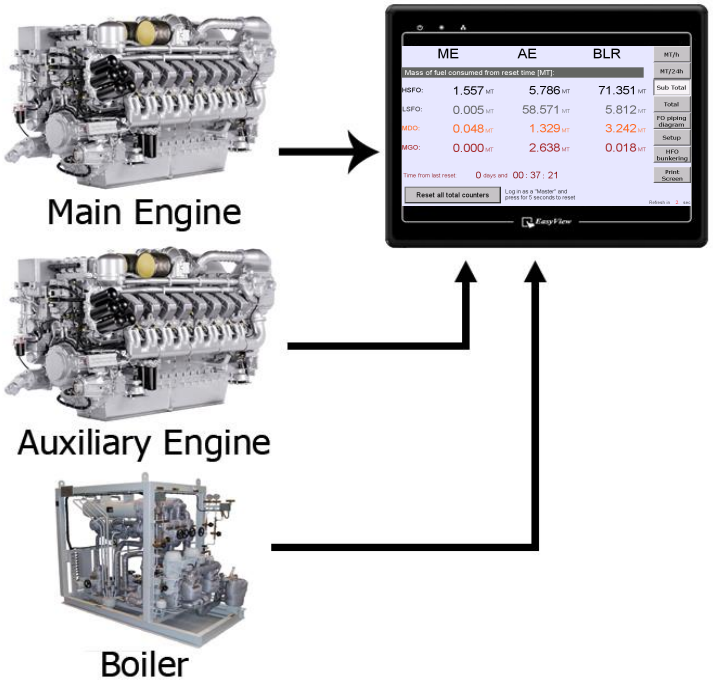
- ETNP-10 allows accurate **propulsion control**, **optimal trimming and precise shaft load control**.

- Possibility of **continuous viewing** of propulsion performance indications in real time allows the crew necessary adjustments to optimize propulsion efficiency and subsequently, to reduce excessive fuel consumption.

- ETNP-10 is able to make **preliminary diagnostic** and warn against propulsion's malfunctions in real time.

Features of EFCM

The EFCM system is a tool for ongoing monitoring of fuel consumption on ships equipped with a pulse flow meter.



- Volume flow meters (pulse)
- Coriolis flow meters (MODBUS)
- Differential measurement (inlet and return flow meter)
- Additional temperature measurement (PT100 on pipe) for each flow meter (offset, filter)
- Automatic density calculation with temperature change – volumetric flow meters (ASTM tables)
- Density measurement from coriolis flow meters
- Detection heavy and light fuel for each system
- Manual swith between high-sulphur and low-sulphur fuel: HSFO/LSFO and MDO/MGO
- Resettable counters
- Bunker screen for bunker operations
- Current mass flow MT/h and MT/24h
- Counters with total fuel consumption MT
- Alarms (High flow 24h - prediction)
- 7’’ TFT color touch screen in ECR, easy to operate
- Output signal in NMEA protocol (standard) for supervisory systems (i.e ESOS2)

Compatible with Pulse and Coriolis Mass Flowmeters.



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EFCM – basic screens

Mass flow per 1h

MT/h	ME HSFO	AE MDO	BLR HSFO
HSFO:	3.409 on	0.000 off	0.302 on
LSFO:	0.000 off	0.000 off	0.000 off
MDO:	0.000 off	0.663 on	0.000 off
MGO:	0.000 off	0.000 off	0.000 off

MT/h | MT/24h | Sub Total | Total | FO piping diagram | Setup | HFO bunkering | Print Screen

Refresh in 1. sec

Mass flow per 24h

MT/24h	ME HSFO	AE MDO	BLR HSFO
HSFO:	85.382 on	0.000 off	7.078 on
LSFO:	0.000 off	0.000 off	0.000 off
MDO:	0.000 off	16.209 on	0.000 off
MGO:	0.000 off	0.000 off	0.000 off

MT/h | MT/24h | Sub Total | Total | FO piping diagram | Setup | HFO bunkering | Print Screen

Refresh in 0. sec

Sub total counters

Mass of fuel consumed from reset time [MT]:

	ME	AE	BLR
HSFO:	1.557 MT	5.786 MT	71.351 MT
LSFO:	0.005 MT	58.571 MT	5.812 MT
MDO:	0.048 MT	1.329 MT	3.242 MT
MGO:	0.000 MT	2.638 MT	0.018 MT

Time from last reset: 0 days and 00 : 37 : 21

Reset all total counters — Log in as a "Master" and press for 5 seconds to reset

MT/h | MT/24h | Sub Total | Total | FO piping diagram | Setup | HFO bunkering | Print Screen

Refresh in 2. sec

Total screen

Total [MT]:

Total fuel consumption from reset time:

HSFO:	78.695 MT
LSFO:	64.388 MT
MDO:	4.618 MT
MGO:	2.656 MT

Time from last reset: 0 days and 00 : 37 : 26

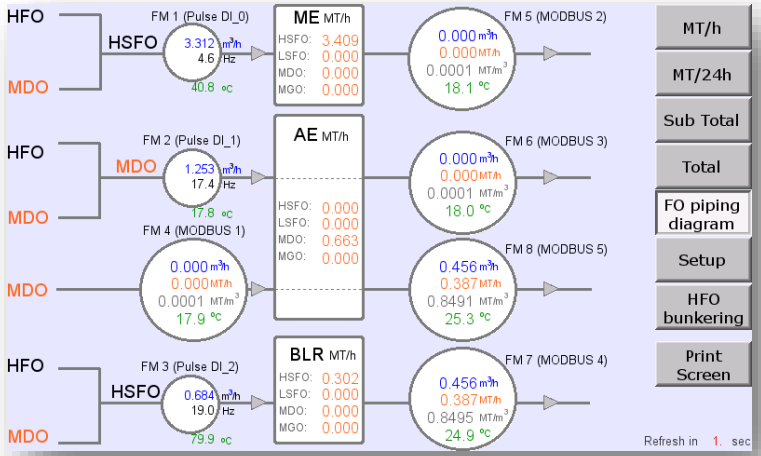
Reset all total counters — Log in as a "Master" and press for 5 seconds to reset

MT/h | MT/24h | Sub Total | Total | FO piping diagram | Setup | HFO bunkering | Print Screen

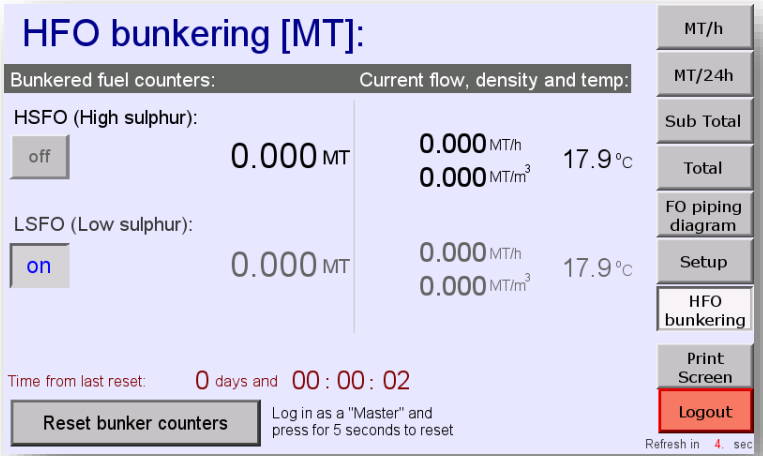
Refresh in 0. sec

EFCM – additional screens

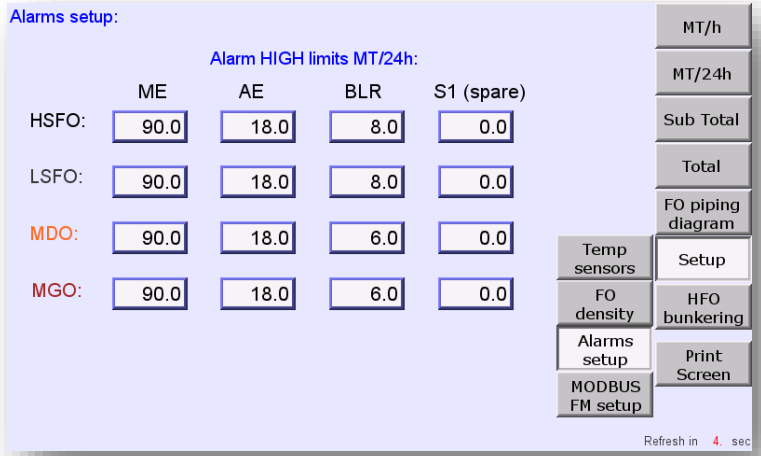
Piping diagram



Bunker screen (under testing onboard)



Alarms setup

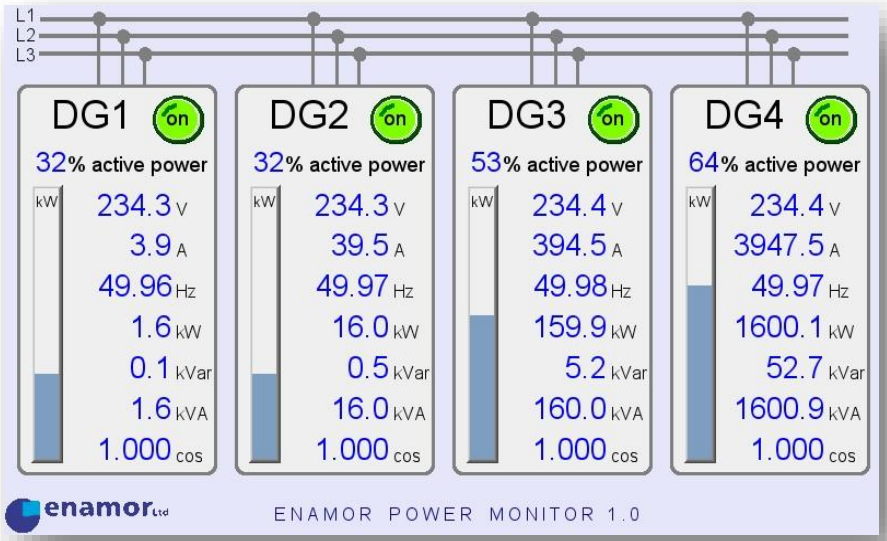


Example MODBUS setup

EPM

Enamor Power Monitor

EPM is a system dedicated to constantly monitor the parameters of electric power plant system, giving a chance setting the generators into higher efficiency.



EPM main screen

Main features:

- Remote power monitoring produced onboard
- Power plant work optimization done by the on shore office through imperative systems (i.e.. ESOS 2.0, Marorka, PIM, EMMA)
- Constant monitoring of power quality onboard (frequency, reactive power, cosinus)
- Automatic work time measurement of each generator (with ESOS 2.0 produced by ENAMOR)
- EPM can be integrated in a greater monitoring and executive system through NMEA protocol communication standard.
- Possible automatic calculation of total Energy (power in time) trip consumption along with ETNP-10 measurements (produced by ENAMOR) with assistance of ESOS 2.0 (produced by ENAMOR)

Measurements and Assembly

EPM Electric Measurements:

- Voltage$_{L-L}$ [V]
- Curent [A]
- Frequency [Hz]
- Active (Real) Power [W]
- Active (Real) Power in ref to max [%]
- Reactive Power [kVar]
- Apparent Power [kVA]
- Cosinus φ [-]

Components:

- Converters

- Software produced by ENAMOR
- Color HMI 7” Touch Panel

HMI, besides live results presentation, is responsible for computing, communication and reporting.

Example Installation:

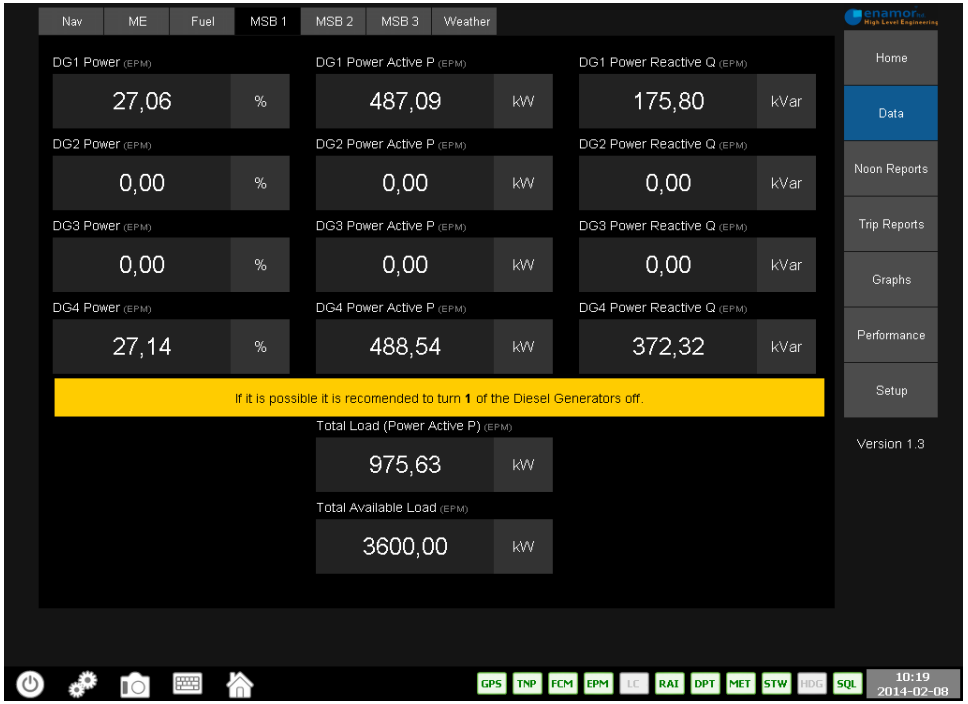
EPM during installation

EPM after installation

Success of Implementation

Enamor Power Monitor in Action:

On the 25.03.2014 our test vessel of western European customer was going though Atlantic Ocean having **3 generators** working on **56 %** power each.
Fuel consumption of all was about **0,750 MT/h**.



ESOS 2.0 suggesting savings.

Instant Online Solution:

Our imperative, ESOS 2.0 system detected possibility of setting the generators in a better work point, boosting their efficiency and suggested this instantly.
Switching off one of the generators made the other two work more efficient, as it was predicted, with working load of **84 %**.

The results were outstanding! The fuel consumption went down about **50 kg/h** to **0,700 MT/h** giving savings **1,2 MT / day** which on average IFO180 price 600 $ gives a savings of **720 $** per day !!

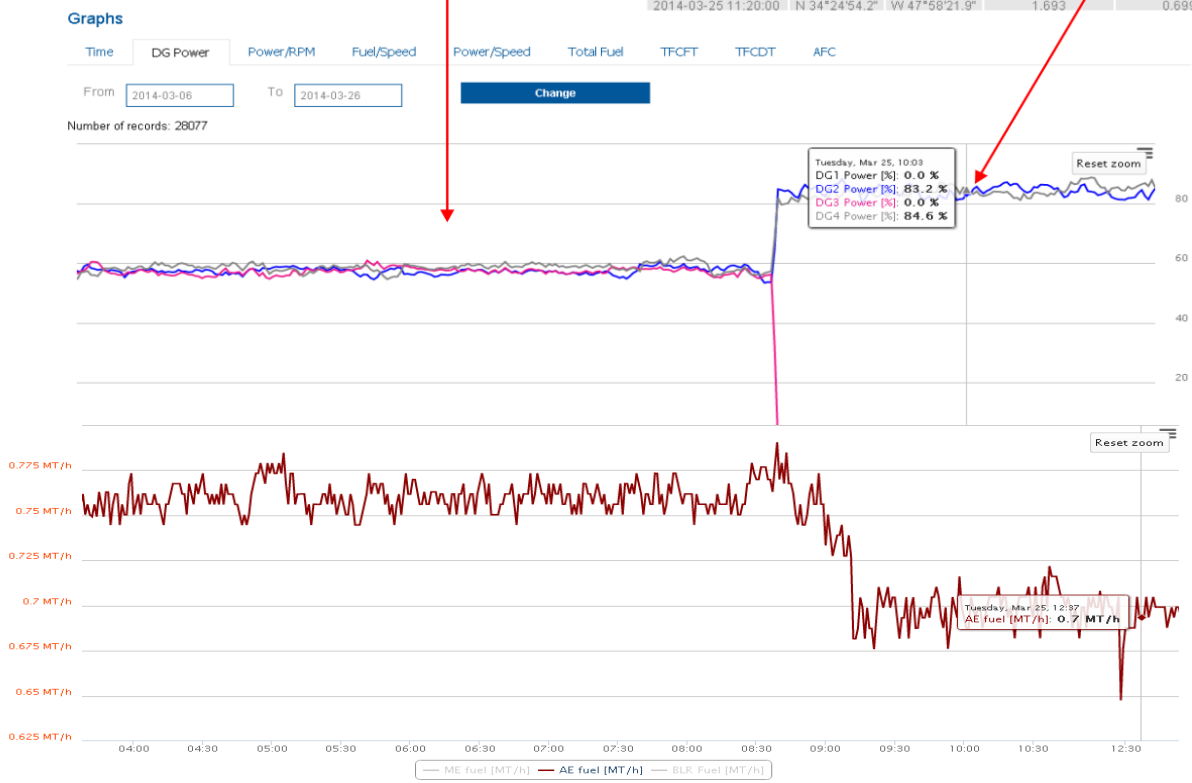
Success of Implementation

Graphic explanation to our example:

2014-03-25 07:51:00	N 33°53'21.3"	W 48°54'47"	1,831	0,762
2014-03-25 07:50:00	N 33°53'12"	W 48°55'2.8"	1,808	0,762
2014-03-25 07:49:00	N 33°53'2.6"	W 48°55'18.3"	1,796	0,762
2014-03-25 07:48:00	N 33°52'53.1"	W 48°55'33.9"	1,831	0,756
2014-03-25 07:47:00	N 33°52'43.8"	W 48°55'49.7"	1,825	0,762
2014-03-25 07:46:00	N 33°52'34.3"	W 48°56'5.3"	1,773	0,745
2014-03-25 07:45:00	N 33°52'24.9"	W 48°56'21.1"	1,813	0,756
2014-03-25 07:44:00	N 33°52'15.6"	W 48°56'36.8"	1,790	0,768
2014-03-25 07:43:00	N 33°52'6.4"	W 48°56'52.6"	1,854	0,762
2014-03-25 07:42:00	N 33°51'57"	W 48°57'8.3"	1,831	0,762

Analysis

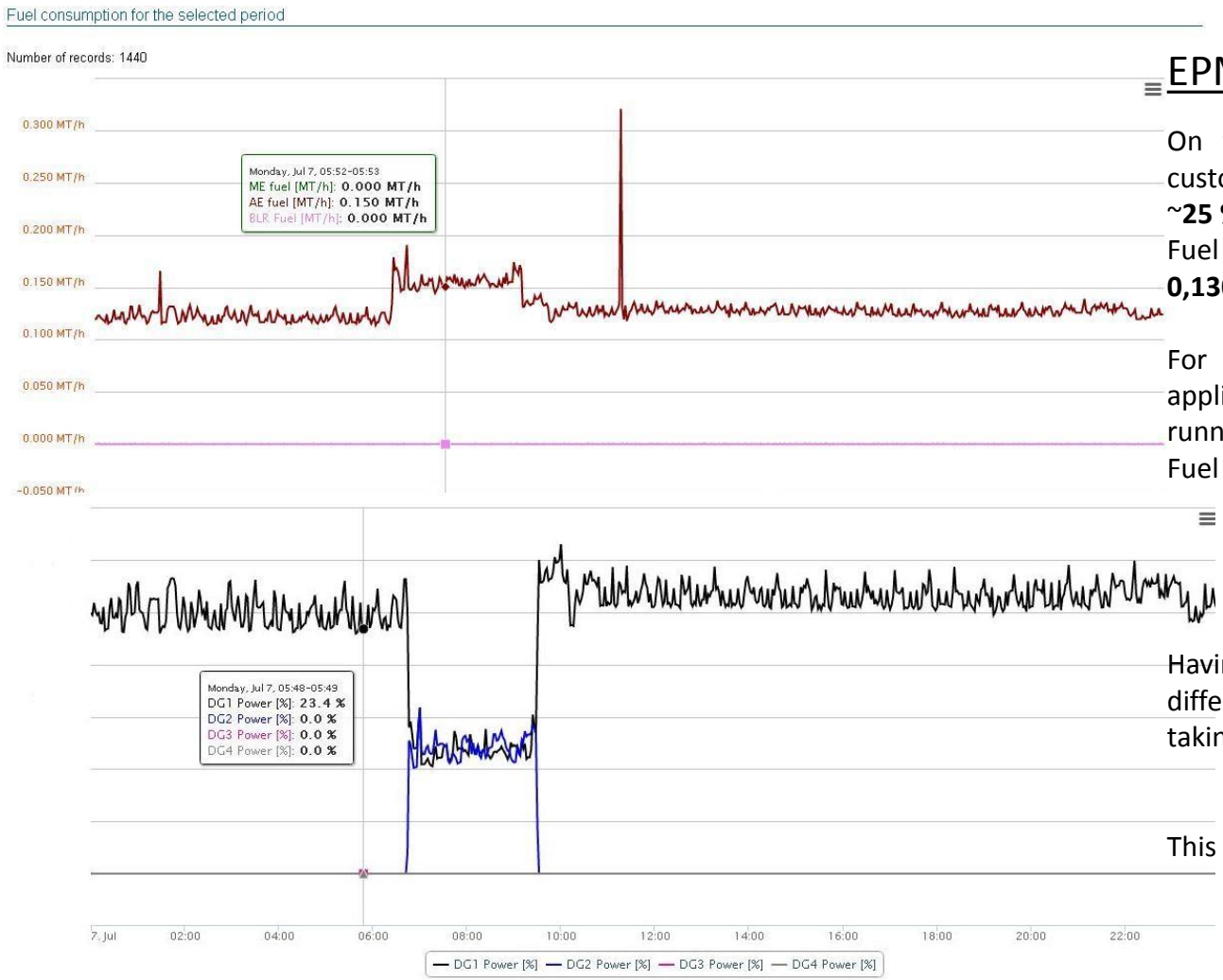
2014-03-25 11:30:00	N 34°26'27.7"	W 47°55'47"	1,739	0,693
2014-03-25 11:29:00	N 34°26'18.4"	W 47°56'2.5"	1,716	0,699
2014-03-25 11:28:00	N 34°26'8.9"	W 47°56'17.9"	1,751	0,710
2014-03-25 11:27:00	N 34°25'59.4"	W 47°56'33.3"	1,733	0,705
2014-03-25 11:26:00	N 34°25'50"	W 47°56'48.5"	1,676	0,705
2014-03-25 11:25:00	N 34°25'40.6"	W 47°57'3.9"	1,756	0,705
2014-03-25 11:24:00	N 34°25'31.4"	W 47°57'19.4"	1,774	0,705
2014-03-25 11:23:00	N 34°25'21.9"	W 47°57'35.2"	1,716	0,699
2014-03-25 11:22:00	N 34°25'12.6"	W 47°57'50.7"	1,693	0,682
2014-03-25 11:21:00	N 34°25'3.3"	W 47°58'6.3"	1,739	0,693
2014-03-25 11:20:00	N 34°24'54.2"	W 47°58'21.9"	1,693	0,699



*Screen shoots were taken form online program **Enamor Vessel Tracker** for on shore office administration.*

Success of Implementation

Graphic example from another Vessel:



EPM – Second Example

On the 07.07.2014 our western European customer vessel had **1 generator** running on ~**25 %** power load.
Fuel consumption was approximately **0,130 MT/h.**

For about 10 minutes, just to test the application, chief started his second **generator** running. Both settle on ~**12,5 %** power each. Fuel consumption was about **0,155 MT/h**.

Having this above example in mind, the difference in fuel consumption would be, taking this very carefully, approximately

0,6 MT/day.

This action gives a savings of **360 $** per day!

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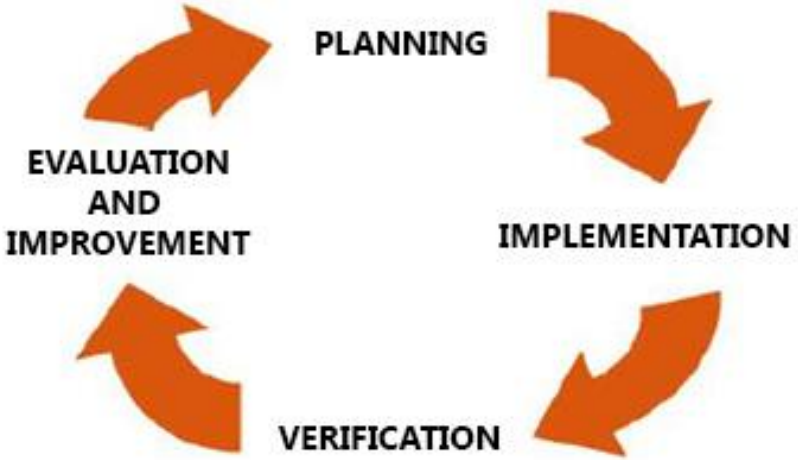
ESOS General Idea – SEEMP Regulation

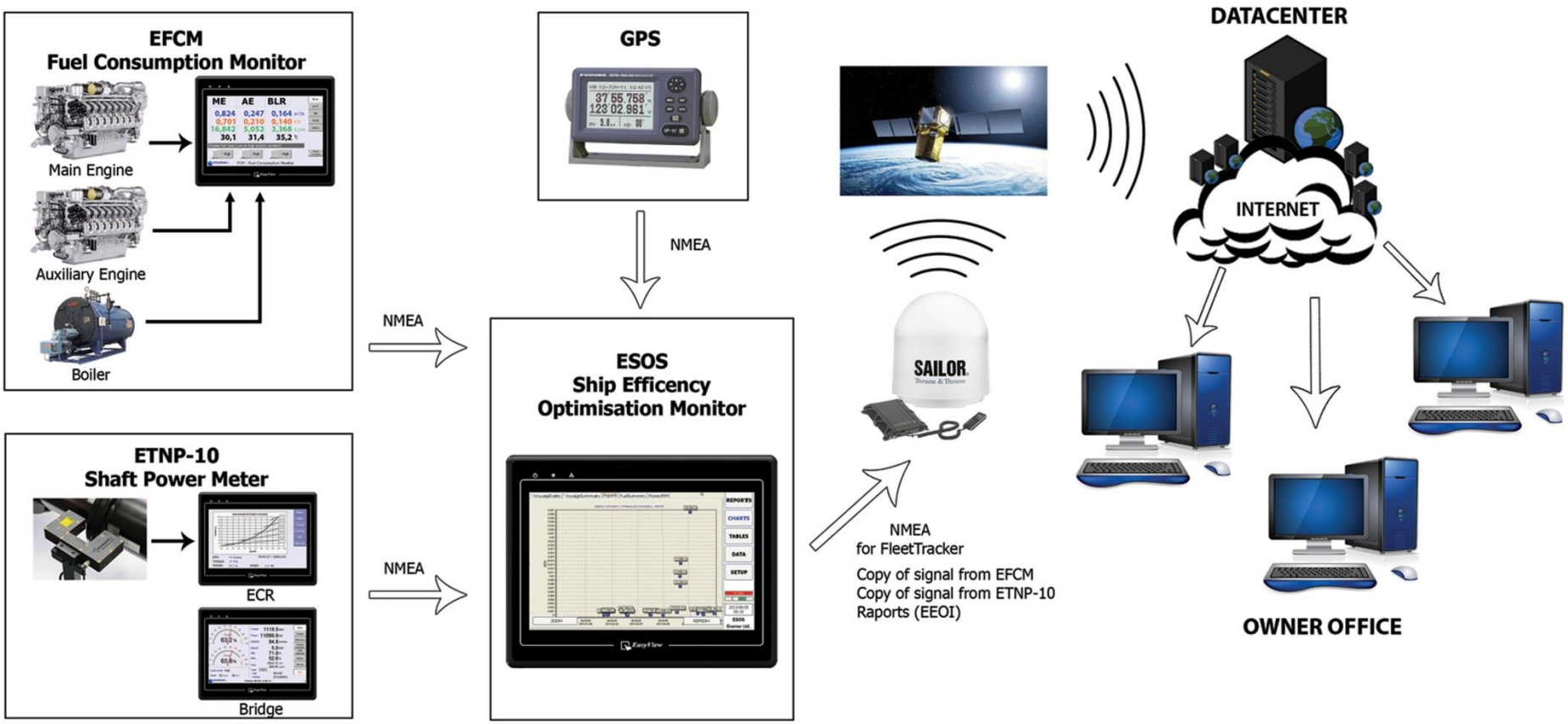
ESOS is a system designed to assist ship-owners and crew in implementing the **Ship Energy Efficiency Management Plan (SEEMP)**.

- **S**hip **E**nergy **E**fficiency **M**anagment **P**lan
- Mandatory for ships from the 1st of January 2013
- Incorporates best practices for the fuel efficient operation of ships
- Dedicated to the vessel
- The idea: Lower fuel consumption → Lower CO2 emission
- Plan → Do → Check → Act



ESOS 1.0 Connection Diagram

Basic data collecting idea

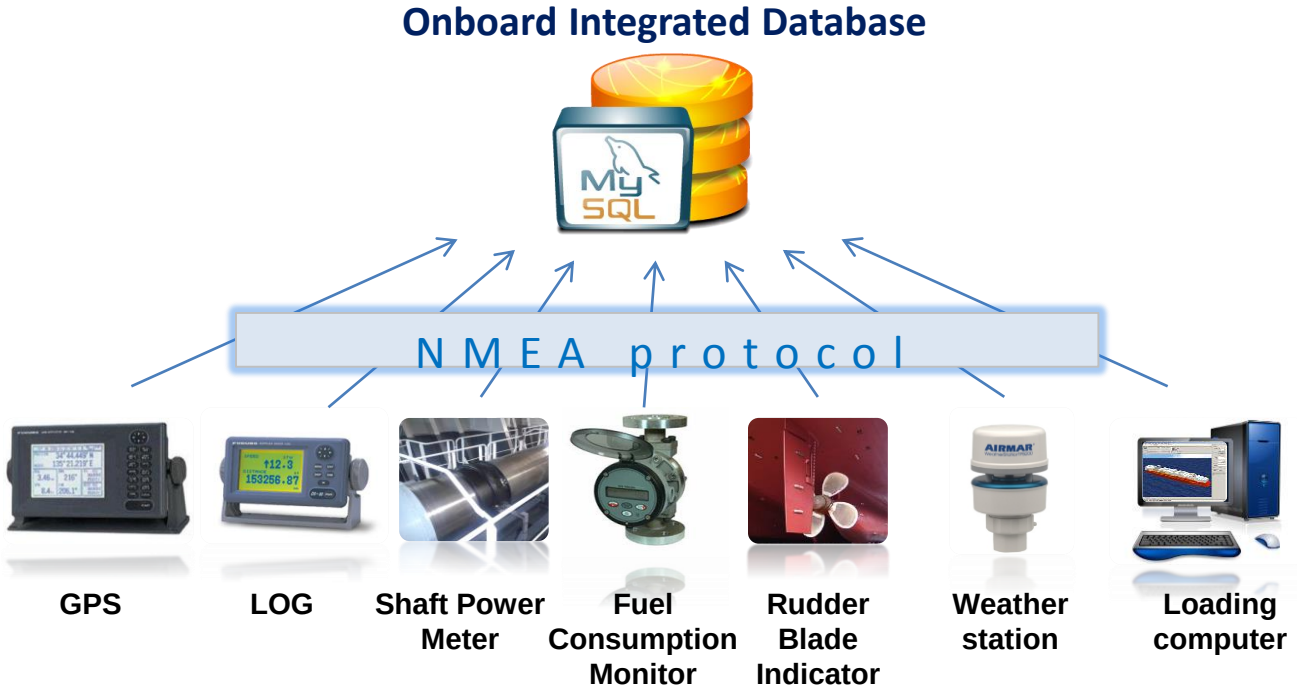


ESOS 2.0 – SEEMP Convention and Integration

ESOS 2.0 is an upgraded version of ESOS 1.0. It was developed to fulfil the blank gap in the market space for counting EEOI and as system integrator.

Now, both of those functionalities are in one device!

ESOS 2.0 besides of assisting ship-owners and crew in implementing the Ship Energy Efficiency Management Plan (**SEEMP**) is a multi purpose system integrator which collects measures and calculates the **performances** while ship operation. It also transfers data and results to the onshore office serwer.



Features and Reports

- ✓ Presentation of data collected from: ETNP-10, EFCM, EPM, GPS, Loading computer, Weather Station, Echosounder and other systems;
- ✓ Creating daily reports (Noon report) and voyage reports (Trip report);
- ✓ Automatic data input when the sensor is connected;
- ✓ Calculation of EEOI (Energy Efficiency Operational Index);
- ✓ Presentation of appropriate combinations of parameters on layouts;
- ✓ Possibility to filtering data;
- ✓ Presentation of performance indicators (6 Performance indicators, Power/Speed Performance Indicator);
- ✓ Sending data and reports using EFTP application to the E-VesselTracker for further analysis;

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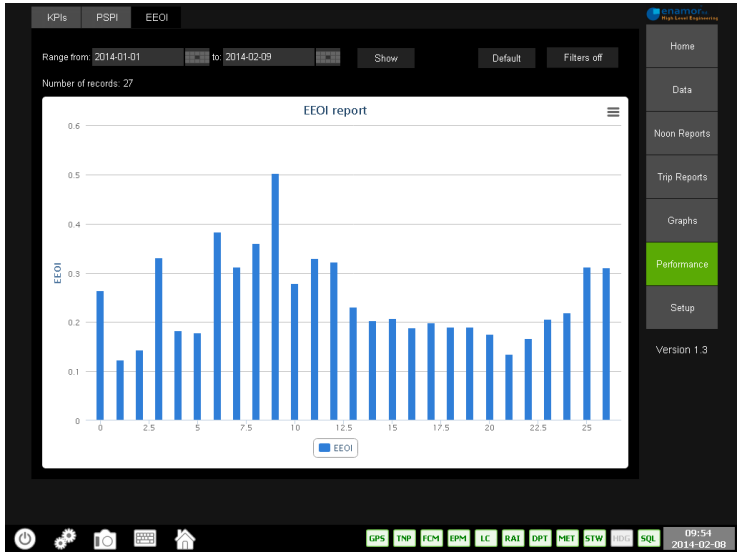
Presentation of ESOS 2.0 Performance Indicators

ESOS 2.0 Performance Indicators

ESOS 2.0 Performance Indicators



ESOS 2.0 EEOI Reports Summary Graph

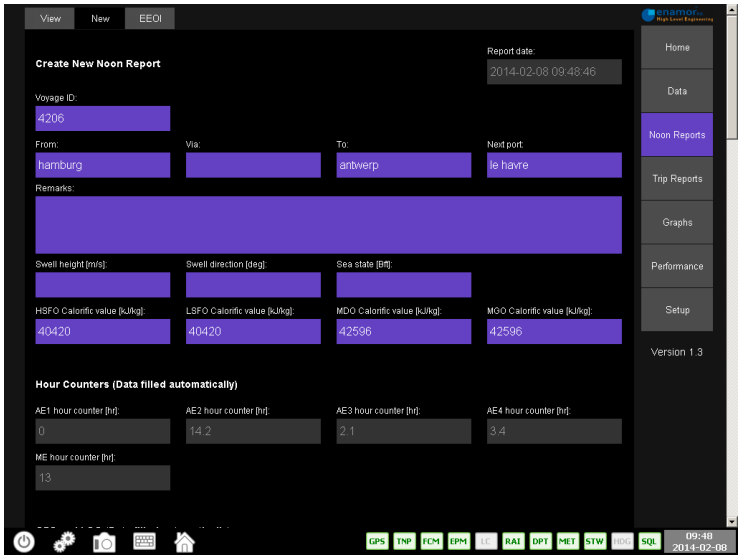
ESOS 2.0 Performance Graphs with insuficient data

Presentation of ESOS 2.0 Data/Report Screens

ESOS 2.0 Fuel Consumption Graph

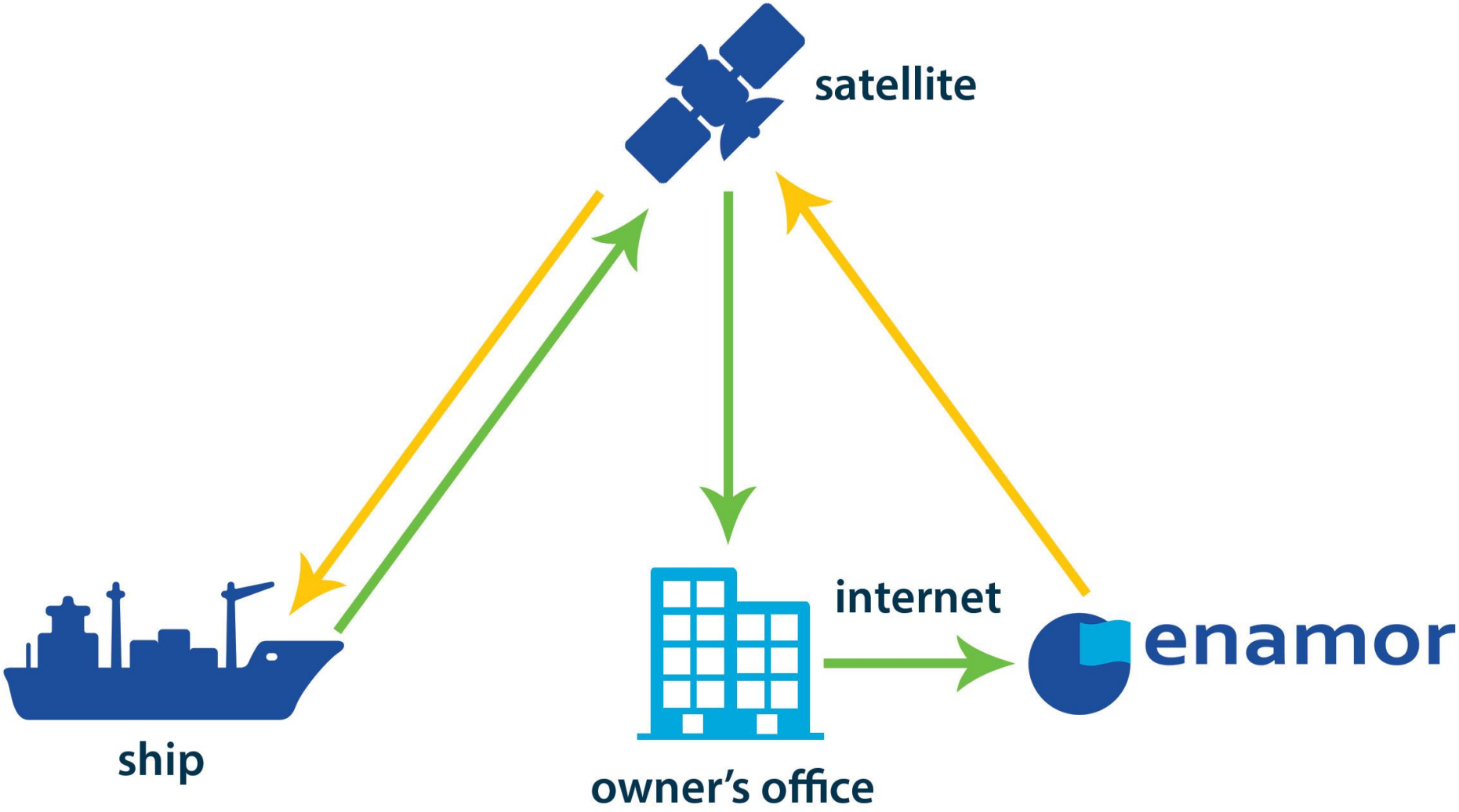
ESOS 2.0 Power vs. RPM Graph

ESOS 2.0 Selected Fuel Consumption Summary Graph



ESOS 2.0 Creating Noon Report

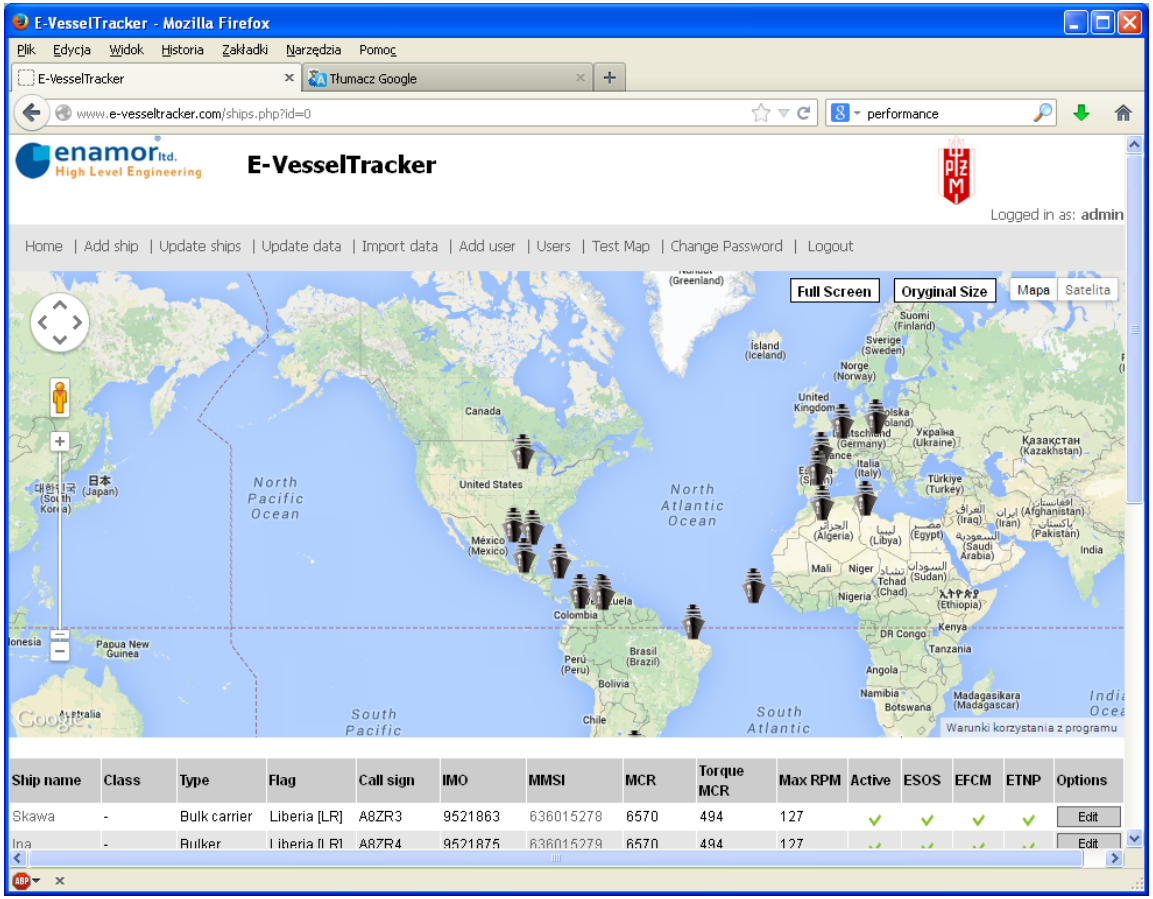
Communication System Schema



E-VesselTracker

EVT is online application responsible for monitoring, analysing and presenting any selected voyage period.

- ✓ In **E-VesselTracker** application it is possible to open several vessels on different tabs.
- ✓ Possibility to compare several ships parameters in **one period of time**.
- ✓ Possibility to compare several ships parameters in **different periods of time**.
- ✓ Possibility to compare ships parameters on **graphs** or **tables**.



E-VesselTracker extends the functionality of our systems:
ETNP-10, EFCM and EPM and ESOS 2.0.

E-VesselTracker Screens

enamor ltd. High Level Engineering — E-VesselTracker

Change password | Logout

Logged in as: demo.

Home | Overview | Measures | Graphs | Analysis | Reports | Settings

Graphs

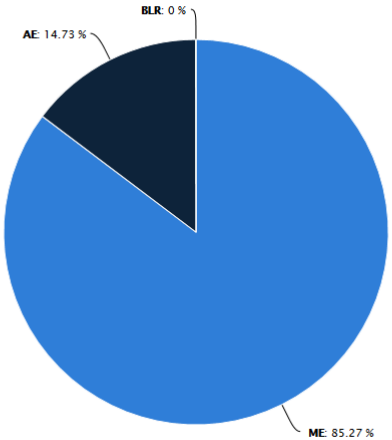
Vessel: m/v Enamor 1, last signal received: 2014-07-14 11:59:00

Time | DG Power | Power/RPM | Fuel/Speed | Power/Speed | Total Fuel | TFCFT | TFCDT | AFC

From 2014-07-07 To 2014-07-14 Change

Number of records: 10800

Total Fuel



Quick message

Name

E-mail address

Message

Send

Contact

PBP Enamor Sp. z o.o.

Phone:
+48 58 69 01 731

E-mail:
project@enamor.com.pl

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E-VesselTracker Screens

enamor ltd. High Level Engineering — E-VesselTracker

Change password | Logout

Logged in as: demo.

Home | Overview | Measures | Graphs | Analysis | Reports | Settings

Measures

Vessel: m/v Enamor 1, last signal received: 2014-07-14 11:59:00

ME | Fuel | Nav & Weather | DG Power | DG Voltage

From 2014-07-07 To 2014-07-14 Change

The average values of ETNP-10 parameters for the selected period

Torque (ETNP-10)		Power (ETNP-10)		RPM (ETNP-10)		Speed Over Ground (ETNP-10)	
32,44	%	20,97	%	66,64	r/min	14,75	kn

Slip Speed Over Ground (ETNP-10)		Efficiency (ETNP-10)		Fuel (ETNP-10)		SFOC (ETNP-10)	
-3,62	%	39,76	%	1492,30	kg/h	223,30	g/kWh

Table of measures

Number of records: 1480

	GPS		ME (ETNP-10)										
Signal Date	Latitude	Longitude	Torque [%]	Torque [kNm]	Power [%]	Power [kW]	RPM [r/min]	RPM [%]	Speed [kn]	Slip [%]	Efficiency [%]	Fuel [kg/h]	SFOC [g/kWh]
2014-07-14 11:59:00	N 13°39'43.9"	W 72°40'3.1"	32,15	944,25	19,75	6318,02	61,52	63,98	12,83	6,13	39,58	1417,63	224,25
2014-07-14 11:58:00	N 13°39'53.9"	W 72°39'54.7"	30,92	908,02	19,02	6083,43	61,49	63,95	12,63	7,54	39,50	1367,23	224,97
2014-07-14 11:57:00	N 13°40'3.7"	W 72°39'46.5"	30,88	907,00	19,02	6083,43	61,67	64,14	12,65	7,70	39,48	1371,08	224,88
2014-07-14 11:56:00	N 13°40'13.1"	W 72°39'37.7"	30,26	888,69	18,60	5950,14	61,49	63,95	12,68	7,18	39,40	1341,48	225,30
2014-07-14 11:55:00	N 13°40'22.4"	W 72°39'28.7"	30,12	884,53	18,60	5950,14	61,72	64,19	12,70	7,41	39,40	1339,67	225,30
2014-07-14 11:54:00	N 13°40'31.4"	W 72°39'19.5"	30,18	886,48	18,58	5944,81	61,69	64,16	12,75	6,99	39,40	1342,07	225,30
2014-07-14 11:53:00	N 13°40'40.6"	W 72°39'10.3"	30,05	882,52	18,48	5912,82	61,55	64,02	12,73	6,91	39,40	1333,17	225,35
2014-07-14 11:52:00	N 13°40'49.7"	W 72°39'1"	29,84	876,45	18,43	5896,82	61,63	64,09	12,77	6,77	39,40	1327,00	225,55
2014-07-14 11:51:00	N 13°40'59.1"	W 72°38'51.7"	30,15	885,51	18,62	5955,47	61,59	64,06	12,85	6,12	39,40	1340,55	225,30
2014-07-14 11:50:00	N 13°41'8.4"	W 72°38'42.4"	30,37	891,87	18,70	5982,13	61,51	63,97	12,95	5,25	39,40	1345,58	225,30
2014-07-14 11:49:00	N 13°41'17.5"	W 72°38'32.9"	30,13	885,02	18,63	5960,80	61,76	64,23	12,95	5,64	39,40	1340,63	225,30
2014-07-14 11:48:00	N 13°41'26.8"	W 72°38'23.7"	30,07	883,06	18,57	5939,48	61,66	64,12	12,97	5,36	39,40	1337,10	225,30
2014-07-14 11:47:00	N 13°41'36.1"	W 72°38'14.4"	30,10	884,04	18,60	5950,14	61,69	64,16	12,97	5,41	39,40	1340,60	225,33
2014-07-14 11:46:00	N 13°41'45.4"	W 72°38'4.9"	29,90	878,16	18,40	5886,16	61,63	64,09	13,02	4,95	39,40	1329,97	225,50

E-VesselTracker Screens

enamor ltd. High Level Engineering — E-VesselTracker

Change password Logout

Logged in as: demo.

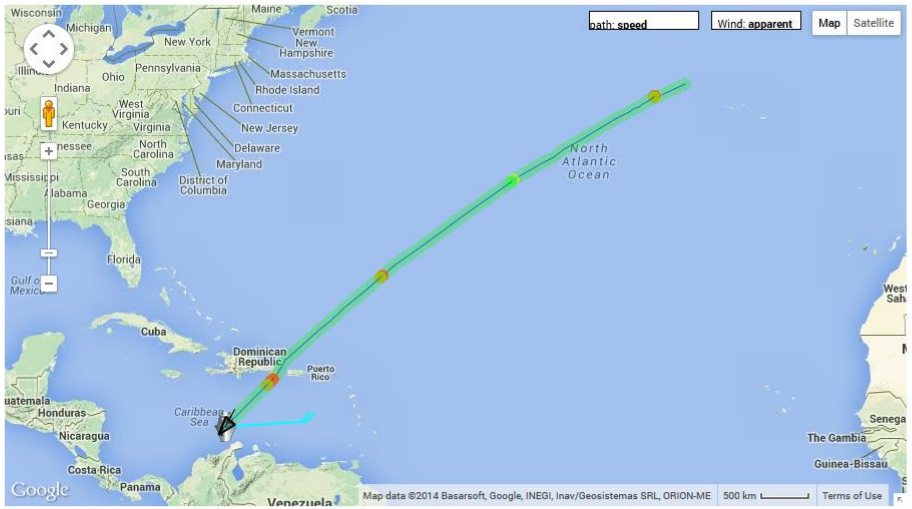
Home | Overview | Measures | Graphs | Analysis | Reports | Settings

Overview

Vessel: m/v Enamor 1, last signal received: 2014-07-14 11:59:00

From 2014-07-07 To 2014-07-14 Change

Map



Vessel: mv Enamor 1

Time stamp:	'2014-07-14 11:59:00'
Latitude:	N 13° 39' 43.854"
Longitude:	W 72° 40' 3.108"
Torque:	32.15 [%]
Power:	19.75 [%]
RPM:	63.98 [r/min]
Speed:	12.83 [kn]
Slip:	6.13 [%]
Efficiency:	39.58 [%]
Fuel:	1417.63 [kg/h]
Calculated SFOC:	224.3 [g/kWh]
COG:	220.2 [deg]
Wind speed rel:	20.84 [kn]
Wind dir rel:	252.00 [deg]
Wind speed true:	27.64 [kn]
Wind dir true:	86.00 [deg]
Water depth:	0.00 [m]
Rudder angle:	3.9 [deg]

Depth (Google Map): 4131.92 [m]

The average values of ETNP-10 parameters for last 24 hours

Torque (ETNP-10)	Power (ETNP-10)	RPM (ETNP-10)	Speed Over Ground (ETNP-10)
30,82 %	20,04 %	65,94 r/min	14,49 kn

Slip Speed Over Ground (ETNP-10)	Efficiency (ETNP-10)	Fuel (ETNP-10)	SFOC (ETNP-10)
-2,56 %	39,54 %	1424,10 kg/h	224,59 g/kWh

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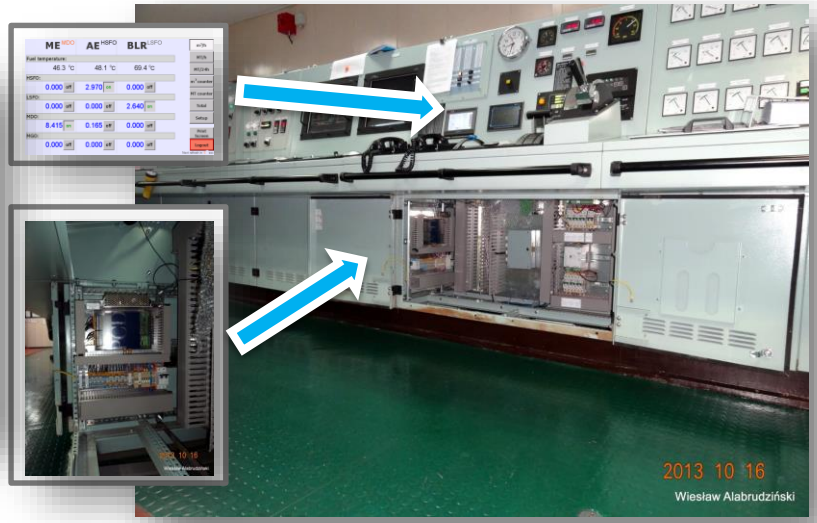
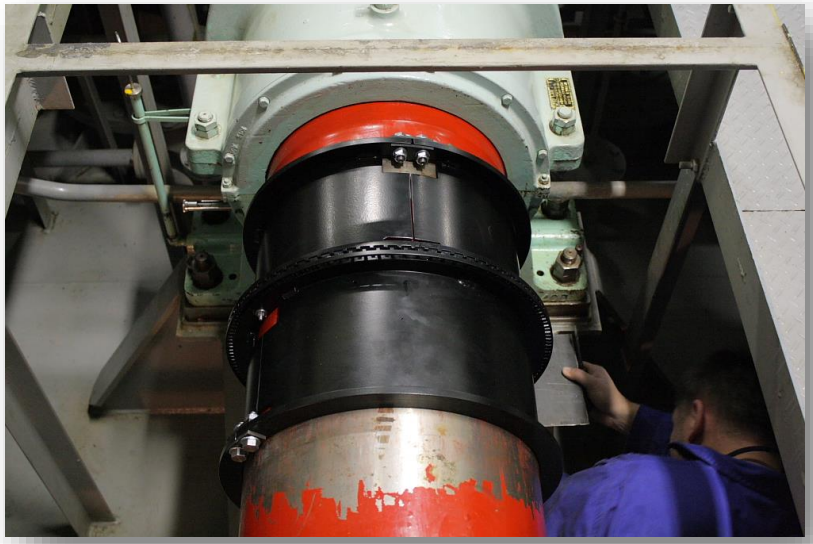
Example Realizations in Pictures

ETNP-10 and EFCM monitors in ECR. *Main units installed in consoles.*



EFCM monitor in ECR.

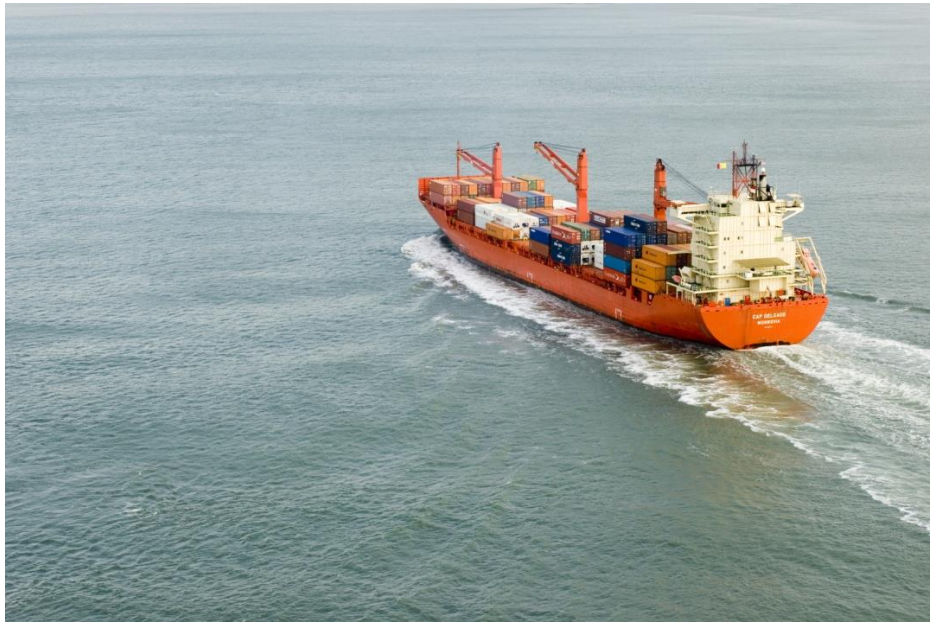
ETNP-10, EFCM and EPM system monitors.



ETNP-10 rings with tooth installed – intermediate shaft.

And this is the voyage…

with…



and without…

…our systems on board ;-)

Thank you for your attention!