Modern Management in Shipping

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Topics

- Voyage Performance monitoring & analysis
  (Επιτήρηση & ανάλυση απόδοσης ταξιδιού)
- Planned Maintenance of machinery & equipment
  (περιοδική συντήρηση μηχανών & εξοπλισμού)

Part 1

Voyage Performance monitoring & analysis

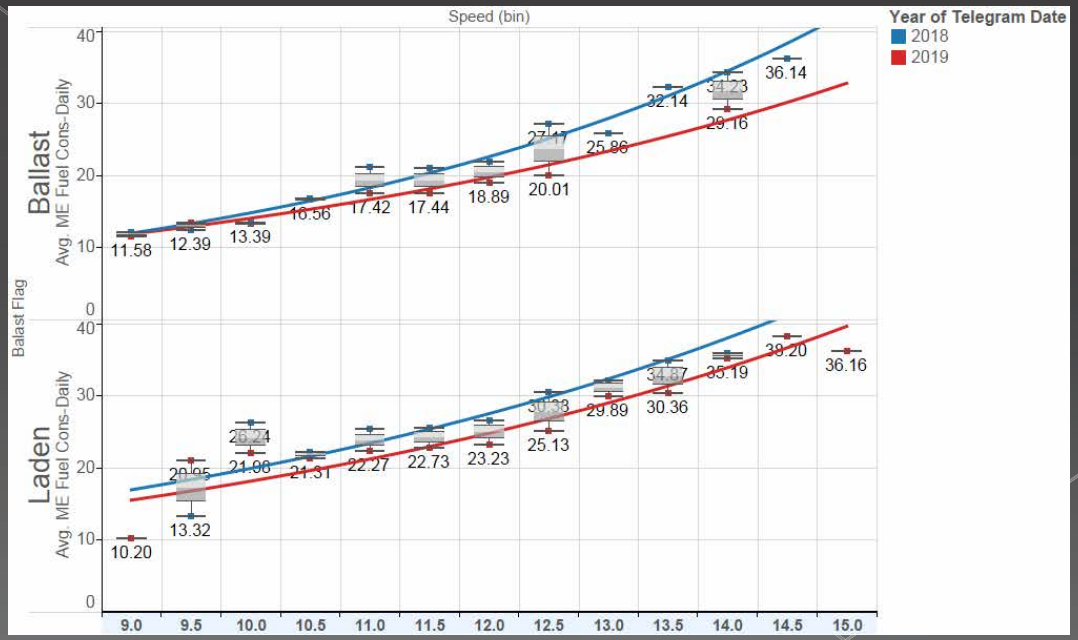
(Επιτήρηση & ανάλυση απόδοσης ταξιδιού)

Voyage Performance monitoring & analysis

Objectives

Performance monitoring is keeping track of how efficiently a vessel operates during her lifetime

Key elements that are monitored are:
-Fuel consumption
-Lubricant oil consumption
-Speed & routing
-Breakdown time
-Out of service & maintenance time



Voyage Performance monitoring & analysis

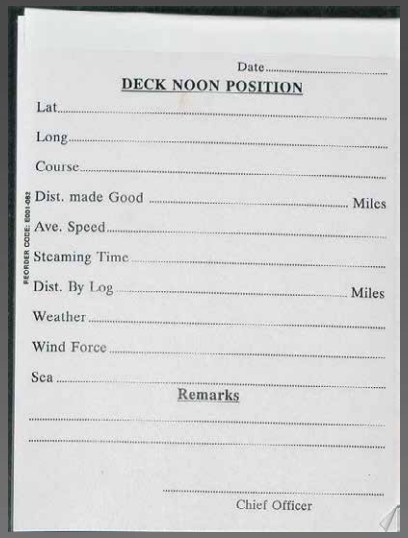
Benefits

- Efficient operation of the vessel ensures that all above elements are kept to an optimum at all times.
- Thus, operational costs of the vessel are minimised, which in turn conveys to better earnings on the owner side.
- In this modern age, there are several tools that assist the operator in making the right decisions how to efficiently operate the vessel.
- Key parameters, regarding the engine, the propeller & the hull are constantly monitored, giving valuable information about the health of the vessel.
- These are reported daily, via noon reports, and on real time to the operator

Voyage Performance monitoring & analysis

A Historical Review

- Noon reports send to the company by vessel, are used to understand and monitor what is happening on the ships.
- These reports are sent by the captain every day at noon, based on data gathered manually by the crew.
- The noon report has grown over the years to give a snapshot of what has happened on board the ship since the previous noon i.e., in the last 24 hours


Date.....

DECK NOON POSITION

Lat.....

Long.....

Course.....

Dist. made Good ..... Miles

Ave. Speed.....

Steaming Time.....

Dist. By Log ..... Miles

Weather.....

Wind Force.....

Sea.....

Remarks

.....

.....

.....

Chief Officer


ENGINEER'S NOON REPORT

M/V-M/T.....

Date..... Voy.....

R.P.M.....

Fuel Consumed..... Bbls

Fuel On Hand..... "

Steaming Time.....

Observed Dist..... Kts

Dist. by Engines..... "

Slip..... %

Fresh Water on Hand..... Tons

Remarks.....

.....

.....

Chief Engineer

Performance monitoring & analysis

A Historical Review

Noon reports in the earlier days when no email services existed, where transmitted as telegrams to the company via telex. Later on telex was replaced by a daily email, that had the same structure as the telex

The information contained in the telegram something like:

- DECK NOON POSITION
- LAT: 06 21.0 N
- LONG: 093 50.0 E
- COURSE: 268
- DIST MADE GOOD: 307 NM
- AVE SPEED: 12.79 KNOTS
- STEAMING TIME: 24HRS
- DIST BY LOG: 318 NM
- WEATHER: SW
- WIND FORCE: 6
- SEA: ROUGH
- ETA COCHIN 23RD JULY 2001 1000 HRS. LT

Location, Speed & prevailing weather condition

- ENGINE NOON REPORT
- R.P.M: 111.3
- FUEL CONSUMED:ME/DG 26.3 MT / 3.1 MT
- FUEL ON HAND:IFO 1031.4 MT
- LS/HSMGO : 25.0 MT/58.6
- STEAMING TIME: 24 HRS
- OBSERVED DIST: 307 NM
- DIST BY ENGINE: 340 NM
- SLIP: 9.7%
- FRESH WATER ON HAND: 159 M3

Fuel consumptions & engine data

Performance monitoring & analysis

A Historical Review

The information was usually encoded to save space and transmission costs

- VPM / Vessel Name
-
1. 1206031200 LT
2. 2123S
3. 03725E
4. 211 / S 4
5. SW 1.0 /1.0
6. 486 /36.75
7. 13.22 / -7.29 /105.20
8. HS 42.4 /LS 0.0 /HSMGO 0.0 /LSMGO 0.0
9. HS 42.4 /LS 0.0 /HSMGO 0.0 /LSMGO 0.0
10. HS 267.2 /LS 229.9 /HSMGO 39.6 /LSMGO 48.0
11. HS 267.2 /LS 229.9 /HSMGO 39.6 /LSMGO 48.0
12. 83/73.5/430
13. MAPUTO / 401
14. 1606032000 LT - AGW/WP (BY AV.SP./12.5)

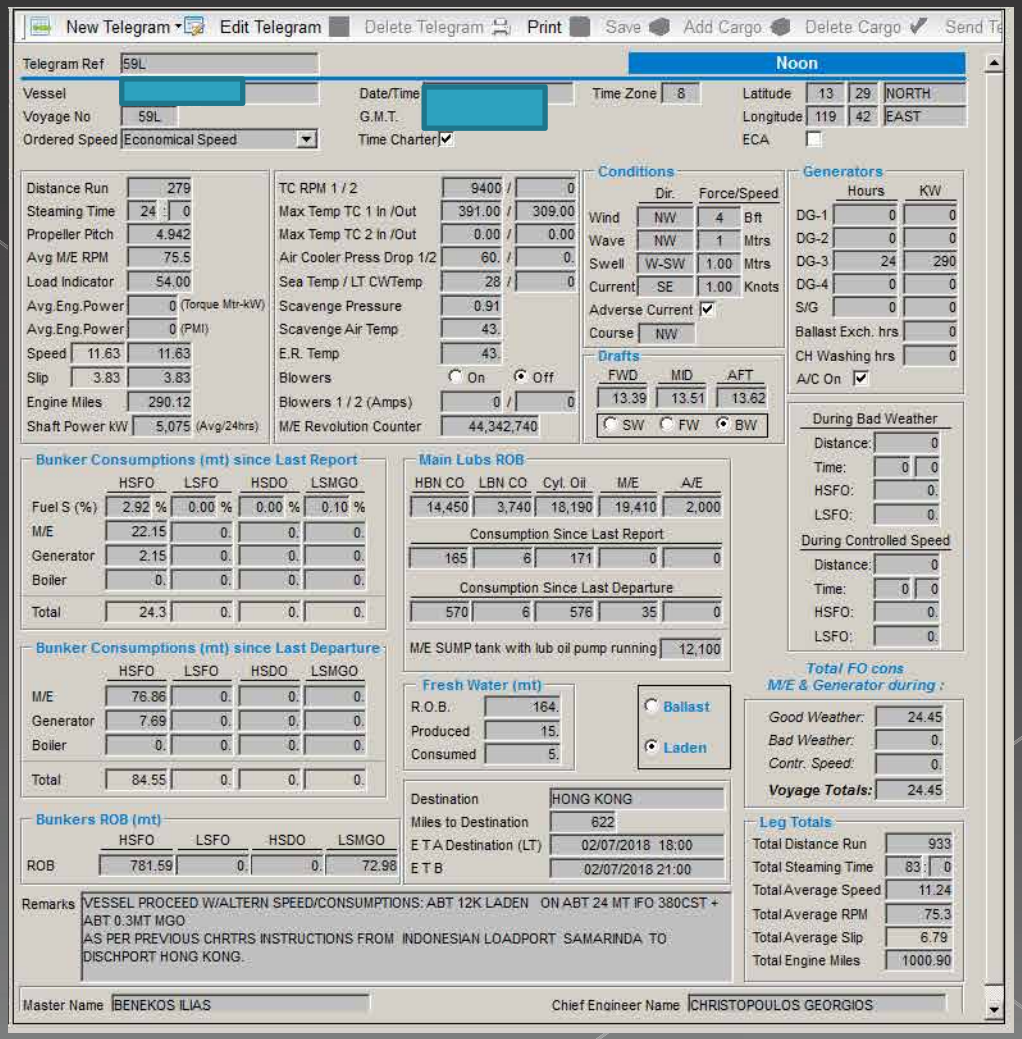
Voyage Performance monitoring & analysis

A Historical Review – Noon Reports

With the evolution of computers, dedicated software replaced the email reporting of noon reports.

More information could be send in a telegram.

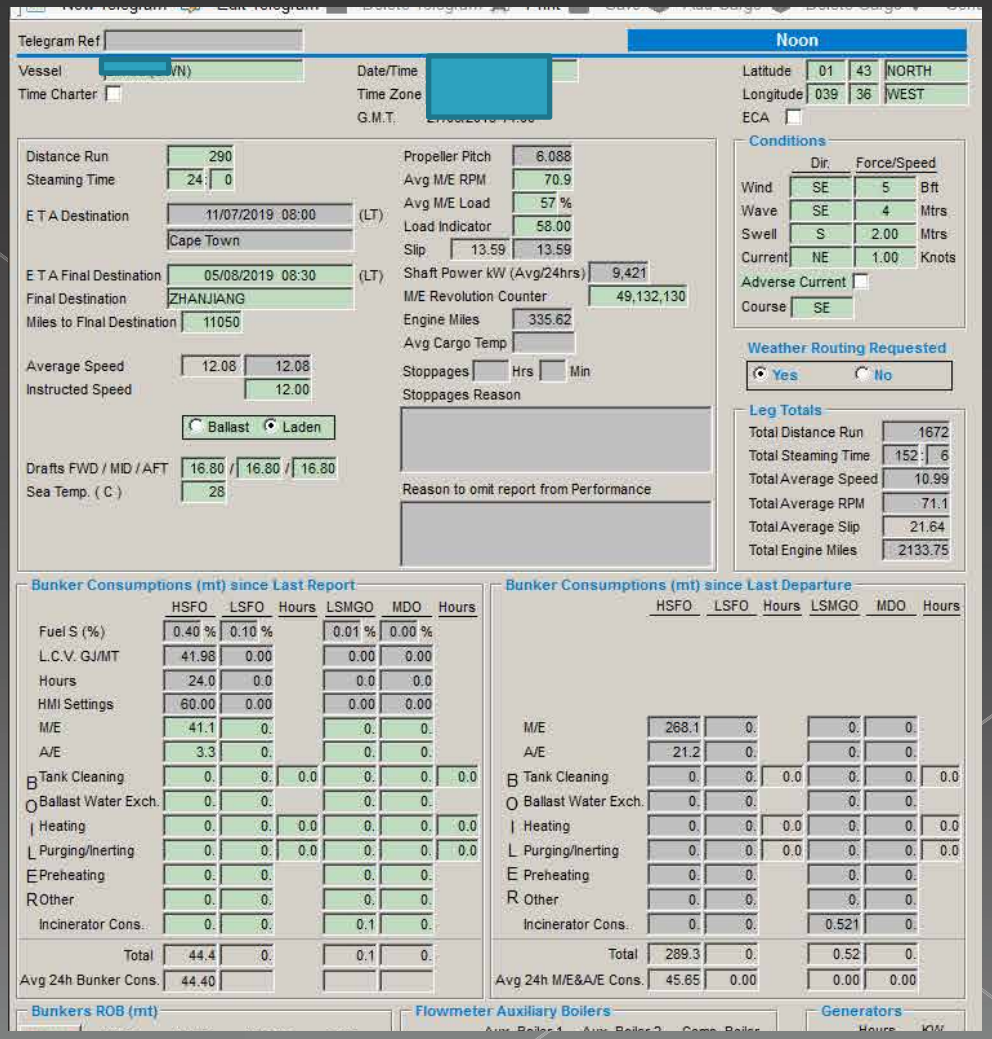
Additionally all information is stored in a database.



Voyage Performance monitoring & analysis

A Historical Review – Noon Reports

With time the number of reported parameters became larger and more details were added.



Telegram Ref

Noon

Vessel [redacted] (PWN)

Date/Time [redacted]

Time Charter ☐

Time Zone [redacted]

G.M.T.

Latitude 01 43 NORTH

Longitude 039 36 WEST

ECA ☐

Distance Run	290
Steaming Time	24 : 0
E T A Destination	11/07/2019 08:00 (LT)
	Cape Town
E T A Final Destination	05/08/2019 08:30 (LT)
Final Destination	ZHANJIANG
Miles to Final Destination	11050
Average Speed	12.08 / 12.08
Instructed Speed	12.00
Ballast ○ Laden ●	
Drafts FWD / MID / AFT	16.80 / 16.80 / 16.80
Sea Temp. (C)	28

Propeller Pitch	6.088
Avg M/E RPM	70.9
Avg M/E Load	57 %
Load Indicator	58.00
Slip	13.59 / 13.59
Shaft Power kW (Avg/24hrs)	9,421
M/E Revolution Counter	49,132,130
Engine Miles	335.62
Avg Cargo Temp	
Stoppages Hrs Min	
Stoppages Reason	
Reason to omit report from Performance	

Conditions

	Dir.	Force/Speed	
Wind	SE	5	Bft
Wave	SE	4	Mtrs
Swell	S	2.00	Mtrs
Current	NE	1.00	Knots
Adverse Current ☐			
Course	SE		

Weather Routing Requested ● Yes ○ No

Leg Totals

Total Distance Run	1672
Total Steaming Time	152 : 6
Total Average Speed	10.99
Total Average RPM	71.1
Total Average Slip	21.64
Total Engine Miles	2133.75

Bunker Consumptions (mt) since Last Report

	HSFO	LSFO	Hours	LSMGO	MDO	Hours
Fuel S (%)	0.40 %	0.10 %		0.01 %	0.00 %	
L.C.V. GJ/MT	41.98	0.00		0.00	0.00	
Hours	24.0	0.0		0.0	0.0	
HMI Settings	60.00	0.00		0.00	0.00	
M/E	41.1	0.		0.	0.	
A/E	3.3	0.		0.	0.	
B Tank Cleaning	0.	0.	0.0	0.	0.	0.0
O Ballast Water Exch.	0.	0.		0.	0.	
I Heating	0.	0.	0.0	0.	0.	0.0
L Purging/Inerting	0.	0.	0.0	0.	0.	0.0
E Preheating	0.	0.		0.	0.	
R Other	0.	0.		0.	0.	
Incinerator Cons.	0.	0.		0.1	0.	
Total	44.4	0.		0.1	0.	
Avg 24h Bunker Cons.	44.40					

Bunker Consumptions (mt) since Last Departure

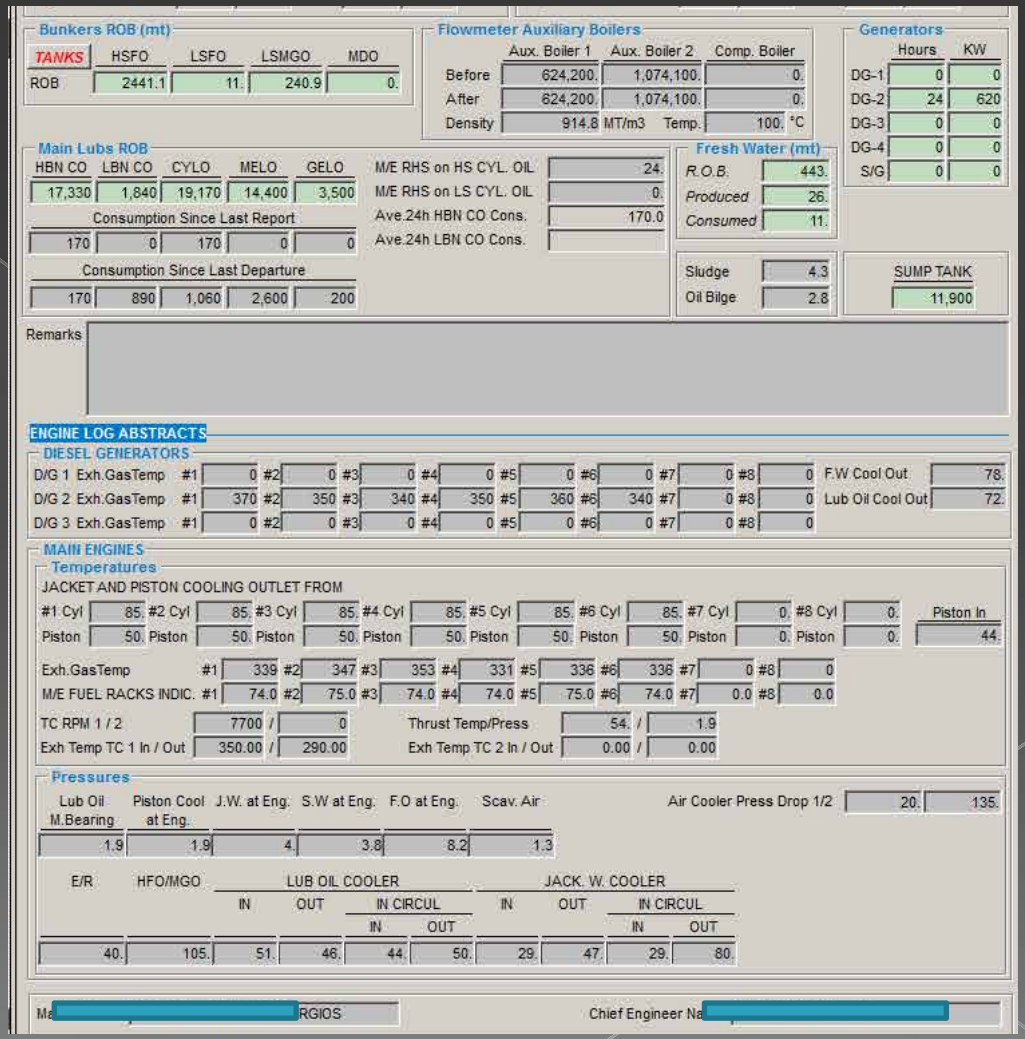
	HSFO	LSFO	Hours	LSMGO	MDO	Hours
M/E	268.1	0.		0.	0.	
A/E	21.2	0.		0.	0.	
B Tank Cleaning	0.	0.	0.0	0.	0.	0.0
O Ballast Water Exch.	0.	0.		0.	0.	
I Heating	0.	0.	0.0	0.	0.	0.0
L Purging/Inerting	0.	0.	0.0	0.	0.	0.0
E Preheating	0.	0.		0.	0.	
R Other	0.	0.		0.	0.	
Incinerator Cons.	0.	0.		0.521	0.	
Total	289.3	0.		0.52	0.	
Avg 24h M/E&A/E Cons.	45.65	0.00		0.00	0.00	

Bunkers ROB (mt) **Flowmeter Auxiliary Boilers** **Generators**

Voyage Performance monitoring & analysis

A Historical Review – Noon Reports

The abstract from the engine log book added as well.



Bunkers ROB (mt)

TANKS	HSFO	LSFO	LSMGO	MDO
ROB	2441.1	11.	240.9	0.

Flowmeter Auxiliary Boilers

	Aux. Boiler 1	Aux. Boiler 2	Comp. Boiler
Before	624,200.	1,074,100.	0.
After	624,200.	1,074,100.	0.
Density	914.8 MT/m3	Temp.	100. °C

Generators

	Hours	KW
DG-1	0	0
DG-2	24	620
DG-3	0	0
DG-4	0	0
S/G	0	0

Main Lubs ROB

HBN CO	LBN CO	CYLO	MELO	GELO
17,330	1,840	19,170	14,400	3,500

Consumption Since Last Report: 170 | 0 | 170 | 0 | 0

Consumption Since Last Departure: 170 | 890 | 1,060 | 2,600 | 200

M/E RHS on HS CYL. OIL	24.
M/E RHS on LS CYL. OIL	0.
Ave.24h HBN CO Cons.	170.0
Ave.24h LBN CO Cons.	

Fresh Water (mt)

R.O.B.	443.
Produced	26.
Consumed	11.

Sludge	4.3
Oil Bilge	2.8

SUMP TANK: 11,900

Remarks

ENGINE LOG ABSTRACTS

DIESEL GENERATORS

D/G 1 Exh.GasTemp	#1	0	#2	0	#3	0	#4	0	#5	0	#6	0	#7	0	#8	0
D/G 2 Exh.GasTemp	#1	370	#2	350	#3	340	#4	350	#5	360	#6	340	#7	0	#8	0
D/G 3 Exh.GasTemp	#1	0	#2	0	#3	0	#4	0	#5	0	#6	0	#7	0	#8	0

F.W Cool Out: 78.

Lub Oil Cool Out: 72.

MAIN ENGINES

Temperatures

JACKET AND PISTON COOLING OUTLET FROM

#1 Cyl	85.	#2 Cyl	85.	#3 Cyl	85.	#4 Cyl	85.	#5 Cyl	85.	#6 Cyl	85.	#7 Cyl	0.	#8 Cyl	0.	Piston In	44.
Piston	50.	Piston	50.	Piston	50.	Piston	50.	Piston	50.	Piston	50.	Piston	0.	Piston	0.		

Exh.GasTemp	#1	339	#2	347	#3	353	#4	331	#5	336	#6	336	#7	0	#8	0
M/E FUEL RACKS INDIC.	#1	74.0	#2	75.0	#3	74.0	#4	74.0	#5	75.0	#6	74.0	#7	0.0	#8	0.0

TC RPM 1 / 2	7700 / 0	Thrust Temp/Press	54. / 1.9
Exh Temp TC 1 In / Out	350.00 / 290.00	Exh Temp TC 2 In / Out	0.00 / 0.00

Pressures

Lub Oil M.Bearing	Piston Cool at Eng.	J.W. at Eng.	S.W at Eng.	F.O at Eng.	Scav. Air	Air Cooler Press Drop 1/2	
1.9	1.9	4.	3.8	8.2	1.3	20.	135.

E/R	HFO/MGO	LUB OIL COOLER				JACK. W. COOLER			
		IN	OUT	IN CIRCUL IN	IN CIRCUL OUT	IN	OUT	IN CIRCUL IN	IN CIRCUL OUT
40.	105.	51.	46.	44.	50.	29.	47.	29.	80.

RGIOS

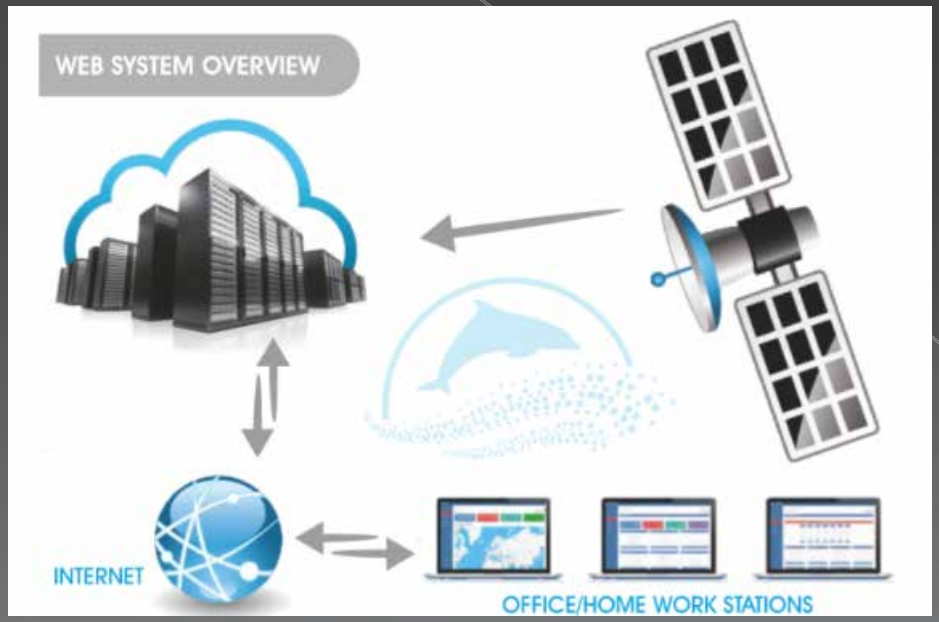
Chief Engineer Na

Voyage Performance monitoring & analysis

A Historical Review – Real Time Data

In addition to noon reports, that are traditionally sent until now at noon, based on local vessel's time, real time data are also collected.

Data are collected from existing sensors and equipment on board (flowmeters, ECDIS, AIS, GPS etc.) and transferred via wired connections into a main unit on board.



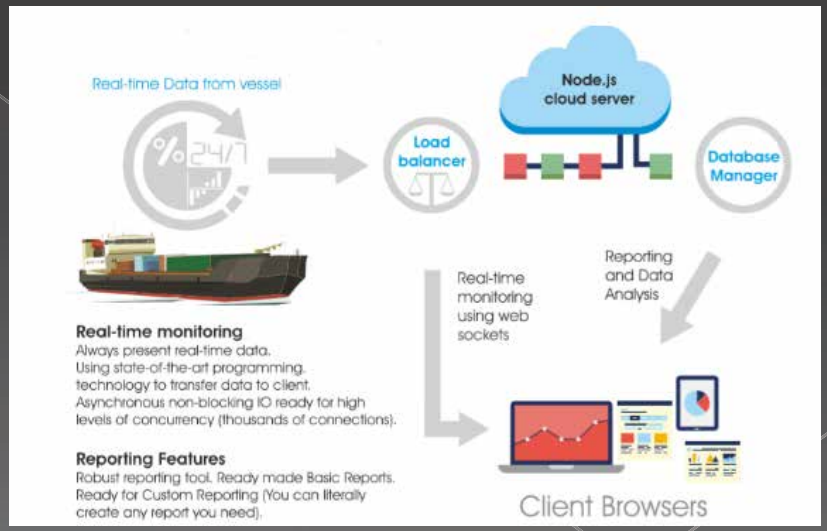
Voyage Performance monitoring & analysis

A Historical Review – Real Time Data

Key parameters are recorded every 5 seconds (and recently every second) and transmitted ashore and stored in dedicated servers.

Parameters monitored include:

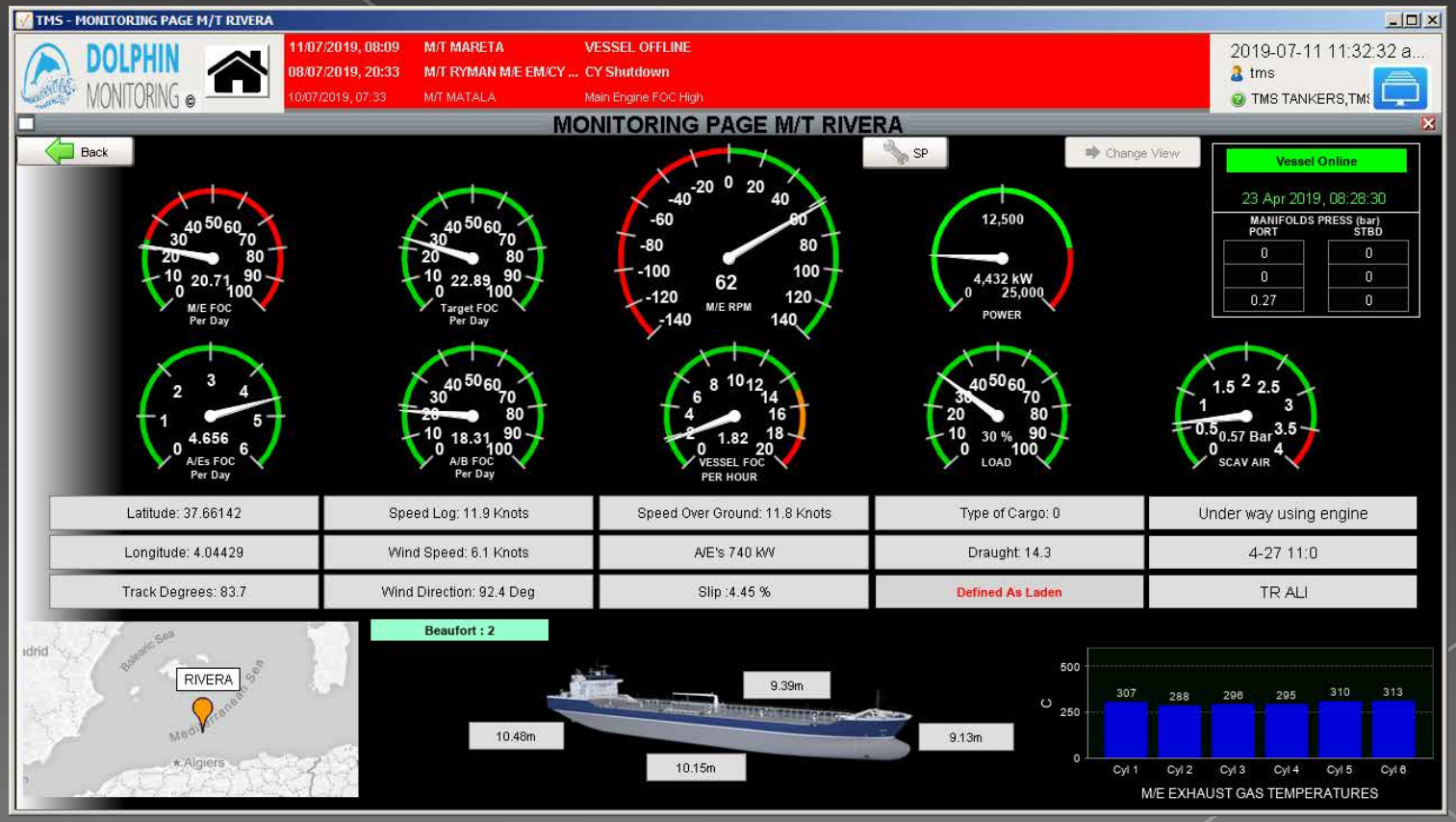
- Vessel Position & Course
- Vessel Speed over ground and through water
- Wind speed and direction
- Actual loading condition of vessel
- Main engine, Diesel Engine, Boiler fuel consumption
- Engine load, shaft power (KW) and propeller speed (RPM)



Voyage Performance monitoring & analysis

A Historical Review – Real Time Data

All data are presented real time, in a graphical format to the operator and any alarms are clearly visible.



Voyage Performance monitoring & analysis

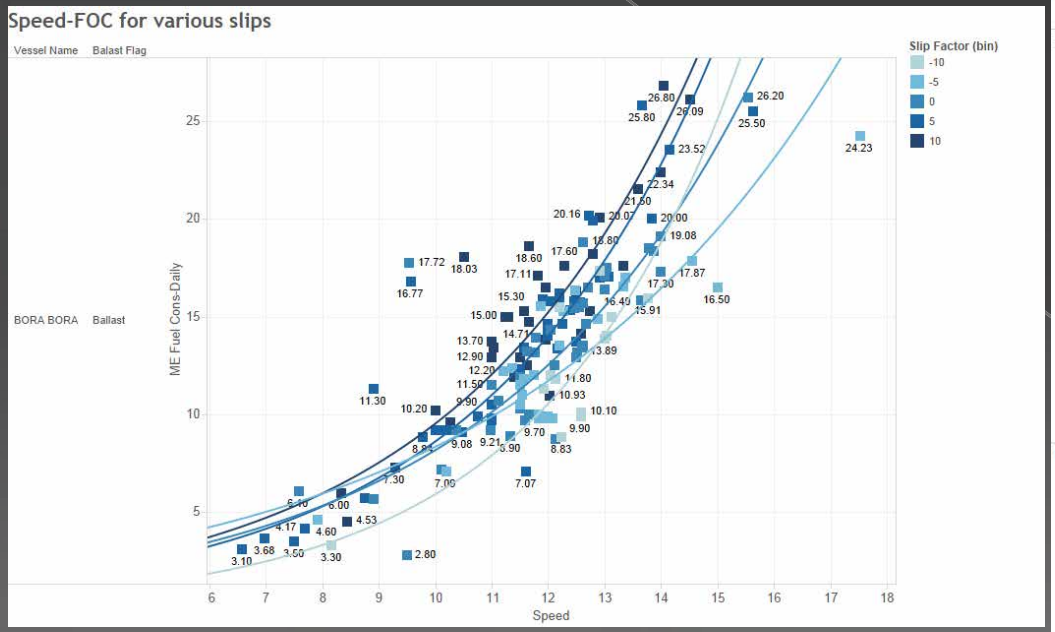
A Historical Review – Real Time Data

The operator can also have analysis of all data received and highlight any abnormalities or deficiencies.

Voyage Performance monitoring & analysis

Performance Analysis

Data collected either from noon reports or real time, are analysed using powerful Business Intelligence (BI) tools:

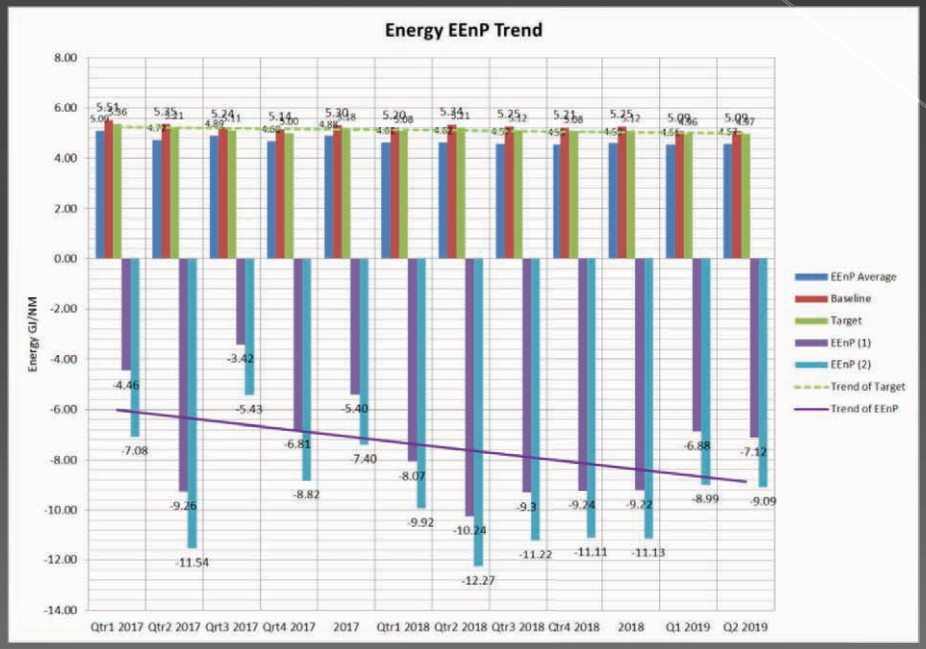


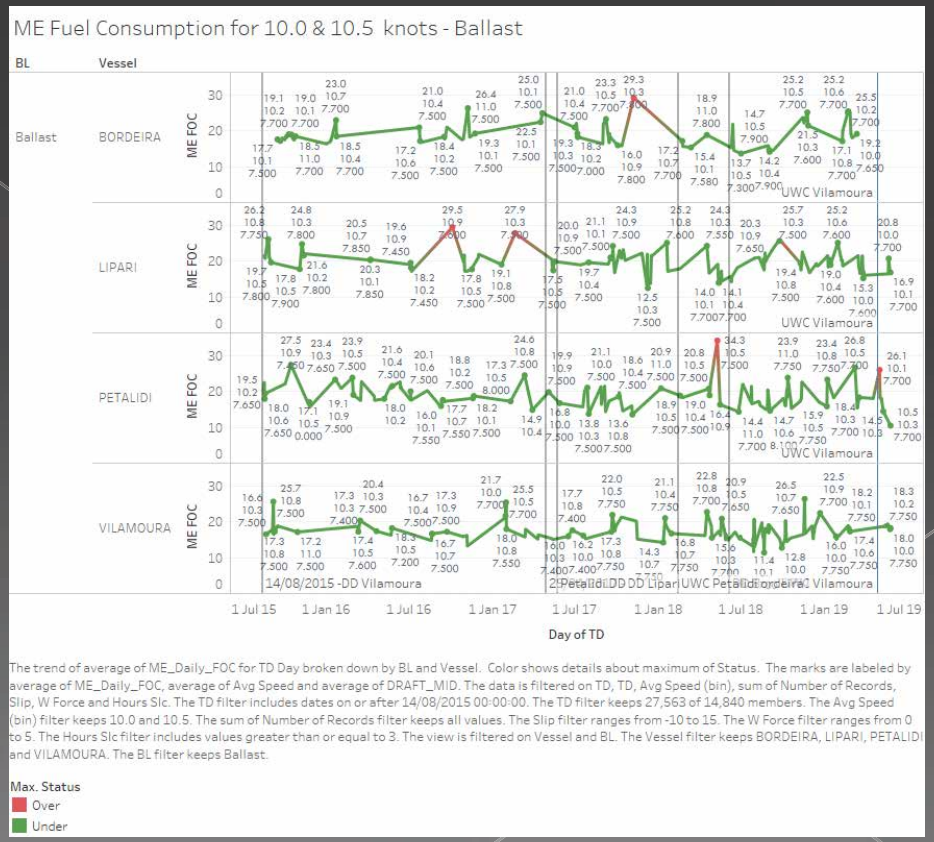
Balast Flag	Performance Speed (current dir absolute) (bi..	Engine Rpm	ME Fuel Cons-Daily	ME+DG Fuel Cons-Daily	Performance Speed (current d.	Slip (for performance speed)	Number of Records
Ballast	8.0	39.0	11.5	15.5	8.2	2.1	38.0
	8.5	40.9	12.7	16.7	8.7	0.9	35.0
	9.0	42.6	14.3	17.9	9.2	-0.9	24.0
	9.5	45.3	15.8	19.5	9.8	0.2	26.0
	10.0	45.8	16.8	20.8	10.3	-3.7	28.0
	10.5	47.0	17.3	21.1	10.7	-5.5	34.0
	11.0	49.2	18.9	22.6	11.2	-5.4	36.0
	11.5	52.0	22.5	26.2	11.7	-4.0	19.0
	12.0	55.1	26.7	30.0	12.2	-2.6	25.0
	12.5	55.4	26.5	30.0	12.8	-6.6	32.0
	13.0	56.7	29.0	32.7	13.2	-7.9	13.0
	13.5	57.7	30.8	34.6	13.7	-9.3	5.0
	14.0	61.5	34.3	37.7	14.3	-6.9	3.0
	14.5	63.0	37.1	40.9	14.6	-6.8	4.0
	15.0	66.0	41.3	44.9	15.1	-5.3	1.0
	15.5	66.7	46.7	52.0	15.9	-10.1	1.0
	16.0						
Laden	8.0	39.4	14.0	18.4	8.4	1.6	4.0
	8.5						
	9.0	49.5	23.6	27.3	9.3	11.4	3.0
	9.5	46.6	21.9	25.9	9.7	2.3	3.0
	10.0	53.5	25.7	29.2	10.3	10.7	12.0
	10.5	53.4	25.8	29.5	10.8	6.4	32.0
	11.0	55.4	28.6	32.3	11.2	6.3	57.0
	11.5	56.2	29.3	32.9	11.8	3.5	120.0
	12.0	57.0	30.0	33.5	12.2	1.1	145.0
	12.5	58.0	30.8	34.4	12.7	-1.3	89.0
	13.0	60.0	34.7	38.3	13.2	-1.5	15.0
	13.5	62.7	40.4	44.1	13.8	-1.7	13.0
	14.0	63.5	42.5	46.1	14.1	-3.4	8.0
	14.5	63.9	45.2	48.4	14.5	-4.8	1.0
	15.0	64.8	42.3	45.4	15.2	-7.9	1.0
	15.5	59.6	32.8	36.4	15.6	-20.8	1.0

Voyage Performance monitoring & analysis

Performance Analysis

Results are compared with baselines and targets set, and KPIs are evaluated. Appropriate actions are taken when the performance KPIs exceed the targets:





Part 2

Planned Maintenance of machinery & equipment

(περιοδική συντήρηση μηχανών & εξοπλισμού)

Planned Maintenance

Definition

Planned maintenance is about documenting and scheduling maintenance activities on vessel machinery and structures.

You can plan to service a system on fixed intervals, inspect for wear, or plan to let, eg, a light bulb fail before you replace it.

To the opposite, unplanned maintenance follows the "fix in when it brakes" rule.

Shipping companies have adopted planned maintenance in order to reduce machinery downtime by having all necessary resources on hand, such as labor and parts, and a strategy on when and how use these resources.

Planned Maintenance

A Historical Review – Unplanned Maintenance

In the early pre-ISM days, the common rule was that the maintenance performed on machinery was after a breakdown.

- No instructions for when or how or what resources to use existed
- No records were kept of any maintenance
- Equipment downtime was longer and

Planned Maintenance

A Historical Review – Planned Maintenance

In the beginning of adoption of ISM code, shipping companies adopted the planned maintenance approach.

The early systems were solely paper based and consisted of:

- Job cards the described the maintenance to be performed
- Maintenance logs for logging down the activities done
- Forms for recording measurements

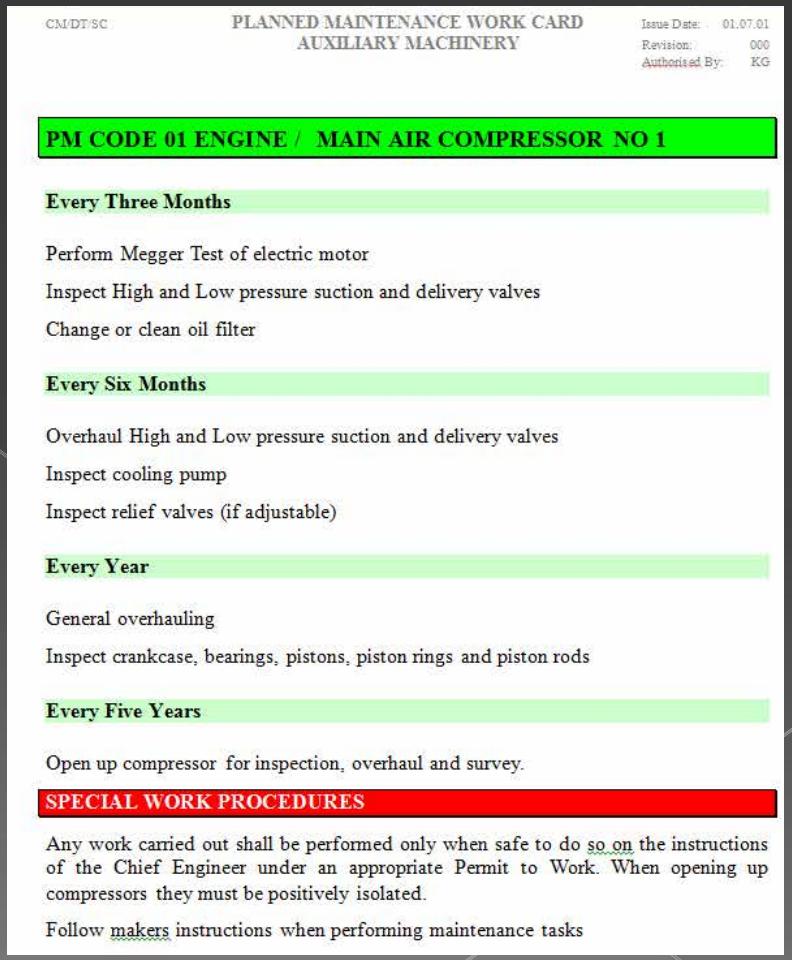
PMS no	Maintenance Item	Critical	Months											
			1	2	3	4	5	6	7	8	9	10	11	12
PM 161	BOW THRUSTER HYDRAULIC PUMP NO 2	X			☐			☐			☐			☐
PM 162	STEERING GEAR	X	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
PM 163	STEERING MOTOR NO 1	X		☐			☐			☐			☐	
PM 164	STEERING MOTOR NO 2	X			☐			☐			☐			☐
PM 165	EMERGENCY GENERATOR	X	☐			☐			☐			☐		
PM 166	MAIN SWITCHBOARD	X		☐			☐			☐			☐	
PM 167	EMERGENCY SWITCHBOARD				☐			☐			☐			☐
PM 168	EMERGENCY FIRE PUMP	X	☐		☐		☐		☐		☐		☐	
PM 169	LIFEBOAT ENGINE NO 1	X		☐						☐				
PM 170	LIFEBOAT ENGINE NO 2	X			☐						☐			
PM 171	ELEVATOR		☐			☐			☐			☐		
PM 172	WORKSHOP - LATHE			☐		☐		☐		☐		☐		☐
PM 173	WORKSHOP - GRINDER				☐			☐			☐			☐
PM 174	WORKSHOP - ELECTRIC WELDER		☐			☐			☐			☐		
PM 175	OXYGEN / ACETYLENE EQUIPMENT			☐			☐			☐			☐	
PM 176	TRAVELLING CRANE				☐			☐			☐			☐
PM 177	SMOKE DETECTOR SAMPLE PUMP NO 1	X	☐			☐			☐			☐		
PM 178	SMOKE DETECTOR SAMPLE PUMP NO 2	X		☐			☐			☐			☐	
PM 179	AUX. BOILER NO 1	X	☐		☐		☐		☐		☐		☐	
PM 180	AUX. BOILER NO 2	X		☐		☐		☐		☐		☐		☐
PM 181	EXHAUST GAS BOILER		☐		☐		☐		☐		☐		☐	

Planned Maintenance

A Historical Review – Job Cards

Paper based planned maintenance systems, although simple to use by vessel's crew have major drawbacks:

- Machinery maintenance instructions and intervals were generic
- No alerts for when jobs became due
- Maintenance history for a machinery was difficult to keep and retrieve when required
- Maintenance of critical machinery could be easily overlooked, thus leading to frequent breakdowns
- Keeping the maintenance system updated was costly and inflexible.



CM/DT/SC

PLANNED MAINTENANCE WORK CARD
AUXILIARY MACHINERY

Issue Date: 01.07.01
Revision: 000
Authorised By: KG

PM CODE 01 ENGINE / MAIN AIR COMPRESSOR NO 1

Every Three Months

Perform Megger Test of electric motor

Inspect High and Low pressure suction and delivery valves

Change or clean oil filter

Every Six Months

Overhaul High and Low pressure suction and delivery valves

Inspect cooling pump

Inspect relief valves (if adjustable)

Every Year

General overhauling

Inspect crankcase, bearings, pistons, piston rings and piston rods

Every Five Years

Open up compressor for inspection, overhaul and survey.

SPECIAL WORK PROCEDURES

Any work carried out shall be performed only when safe to do so on the instructions of the Chief Engineer under an appropriate Permit to Work. When opening up compressors they must be positively isolated.

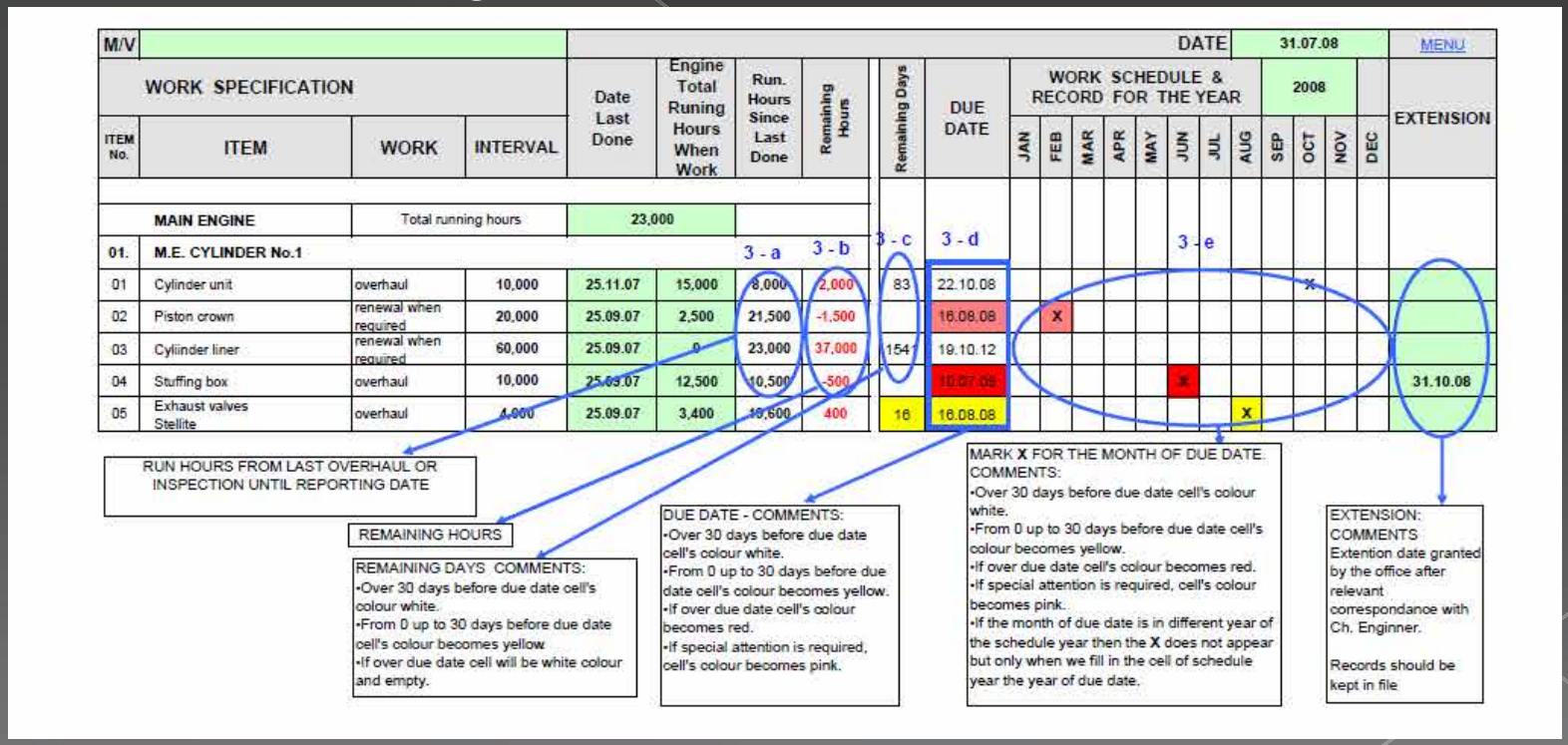
Follow makers instructions when performing maintenance tasks

Planned Maintenance

A Historical Review – Early computerized systems

A first approach to introducing computerized systems for planned maintenance was the spreadsheet based systems (Excel)

Although this approach solves partly the problem with generic job activities and alerting, it is still difficult to follow up and maintain.



M/V										DATE	31.07.08											MENU
WORK SPECIFICATION				Date Last Done	Engine Total Runing Hours When Work	Run. Hours Since Last Done	Remaining Hours	Remaining Days	DUE DATE	WORK SCHEDULE & RECORD FOR THE YEAR									2008				EXTENSION
ITEM No.	ITEM	WORK	INTERVAL							JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
	MAIN ENGINE	Total running hours		23,000																		
01.	M.E. CYLINDER No.1					3 - a	3 - b	3 - c	3 - d						3 - e							
01	Cylinder unit	overhaul	10,000	25.11.07	15,000	8,000	2,000	83	22.10.08										X			
02	Piston crown	renewal when required	20,000	25.09.07	2,500	21,500	-1,500		16.08.08		X											
03	Cylinder liner	renewal when required	60,000	25.09.07	0	23,000	37,000	154	19.10.12													
04	Stuffing box	overhaul	10,000	25.09.07	12,500	10,500	-500		16.08.08						X							31.10.08
05	Exhaust valves Stellite	overhaul	4,000	25.09.07	3,400	10,600	400	16	16.08.08								X					

RUN HOURS FROM LAST OVERHAUL OR INSPECTION UNTIL REPORTING DATE

REMAINING HOURS

REMAINING DAYS COMMENTS:
- Over 30 days before due date cell's colour white.
- From 0 up to 30 days before due date cell's colour becomes yellow.
- If over due date cell will be white colour and empty.

DUE DATE - COMMENTS:
- Over 30 days before due date cell's colour white.
- From 0 up to 30 days before due date cell's colour becomes yellow.
- If over due date cell's colour becomes red.
- If special attention is required, cell's colour becomes pink.

MARK **X** FOR THE MONTH OF DUE DATE.
COMMENTS:
- Over 30 days before due date cell's colour white.
- From 0 up to 30 days before due date cell's colour becomes yellow.
- If over due date cell's colour becomes red.
- If special attention is required, cell's colour becomes pink.
- If the month of due date is in different year of the schedule year then the **X** does not appear but only when we fill in the cell of schedule year the year of due date.

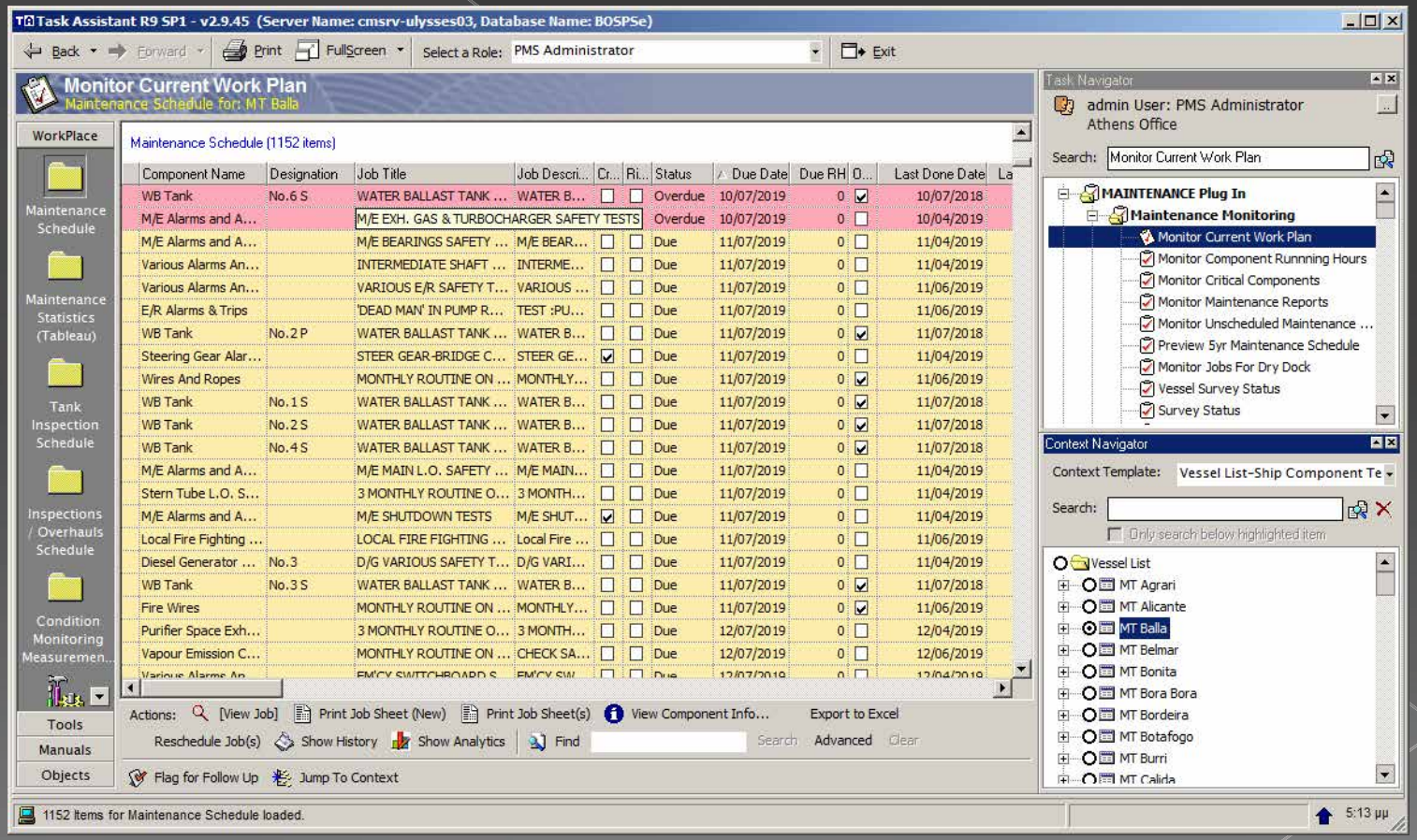
EXTENSION:
COMMENTS
Extention date granted by the office after relevant correspondance with Ch. Enginner.

Records should be kept in file

Planned Maintenance

A Historical Review – Modern PMS Systems

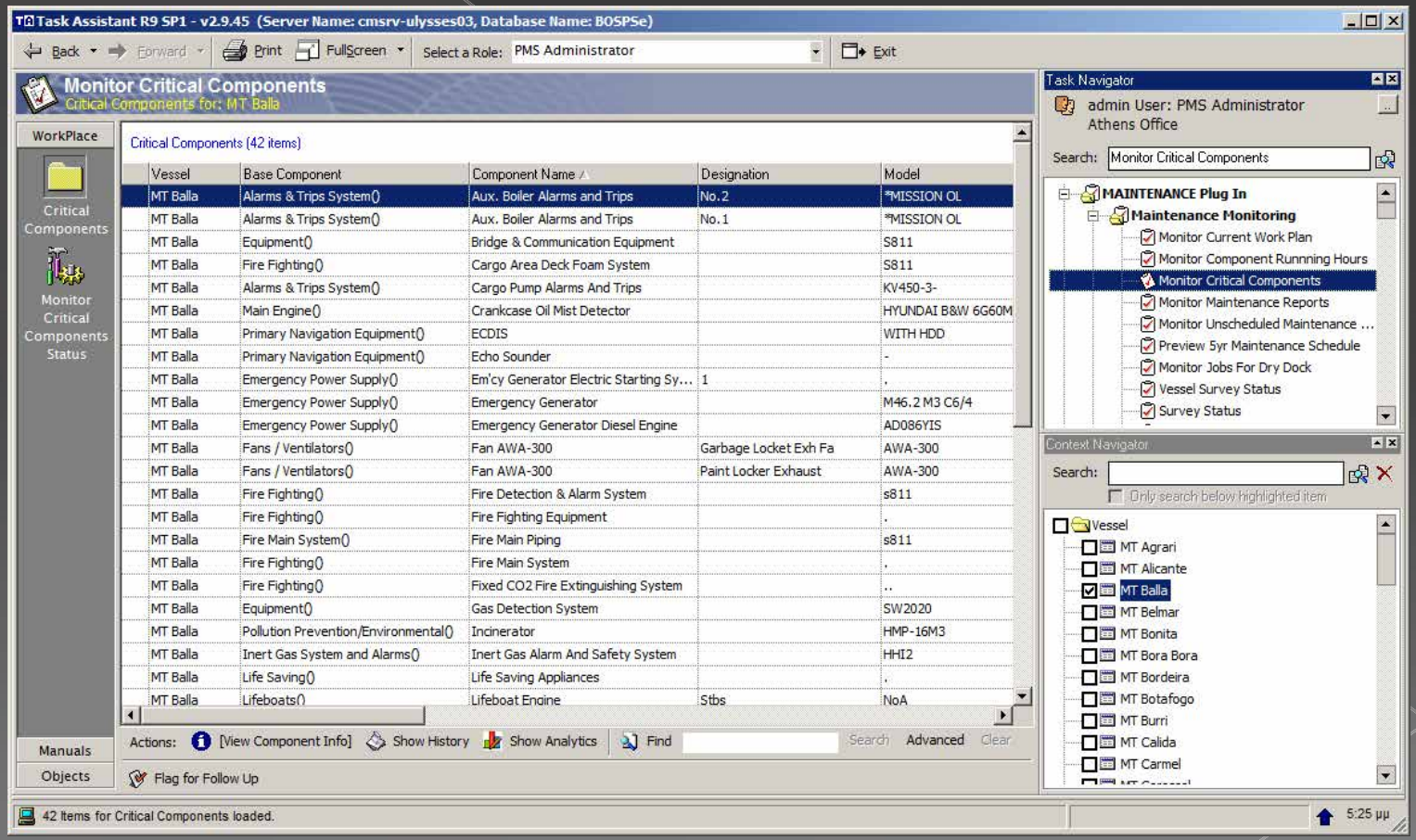
Contemporary computerized systems such as Task Assistant are addressing all these problems and introduce more capabilities



Planned Maintenance

Modern PMS Systems

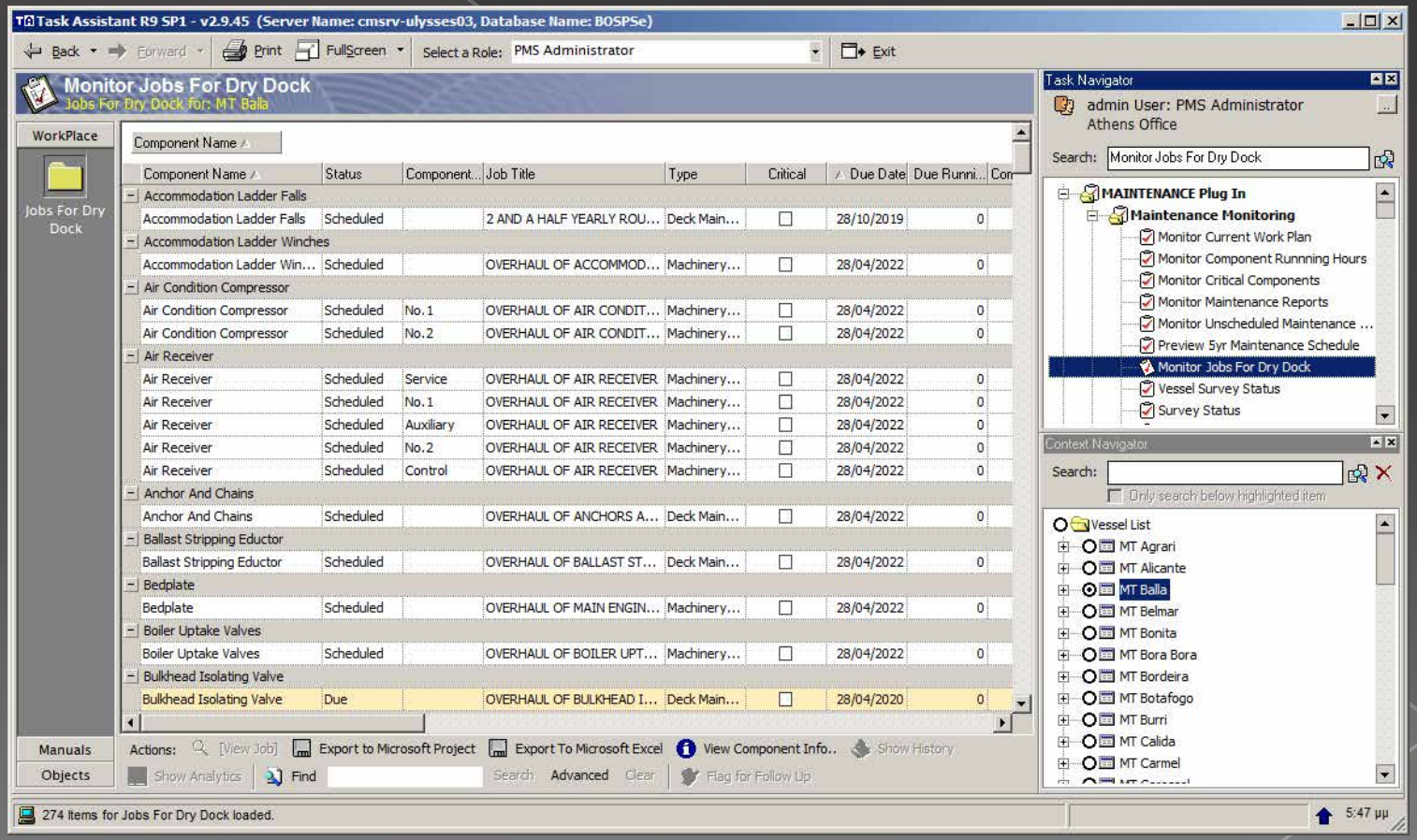
Critical Machinery is easily identified and all activities related to them are given priority:



Planned Maintenance

Modern PMS Systems

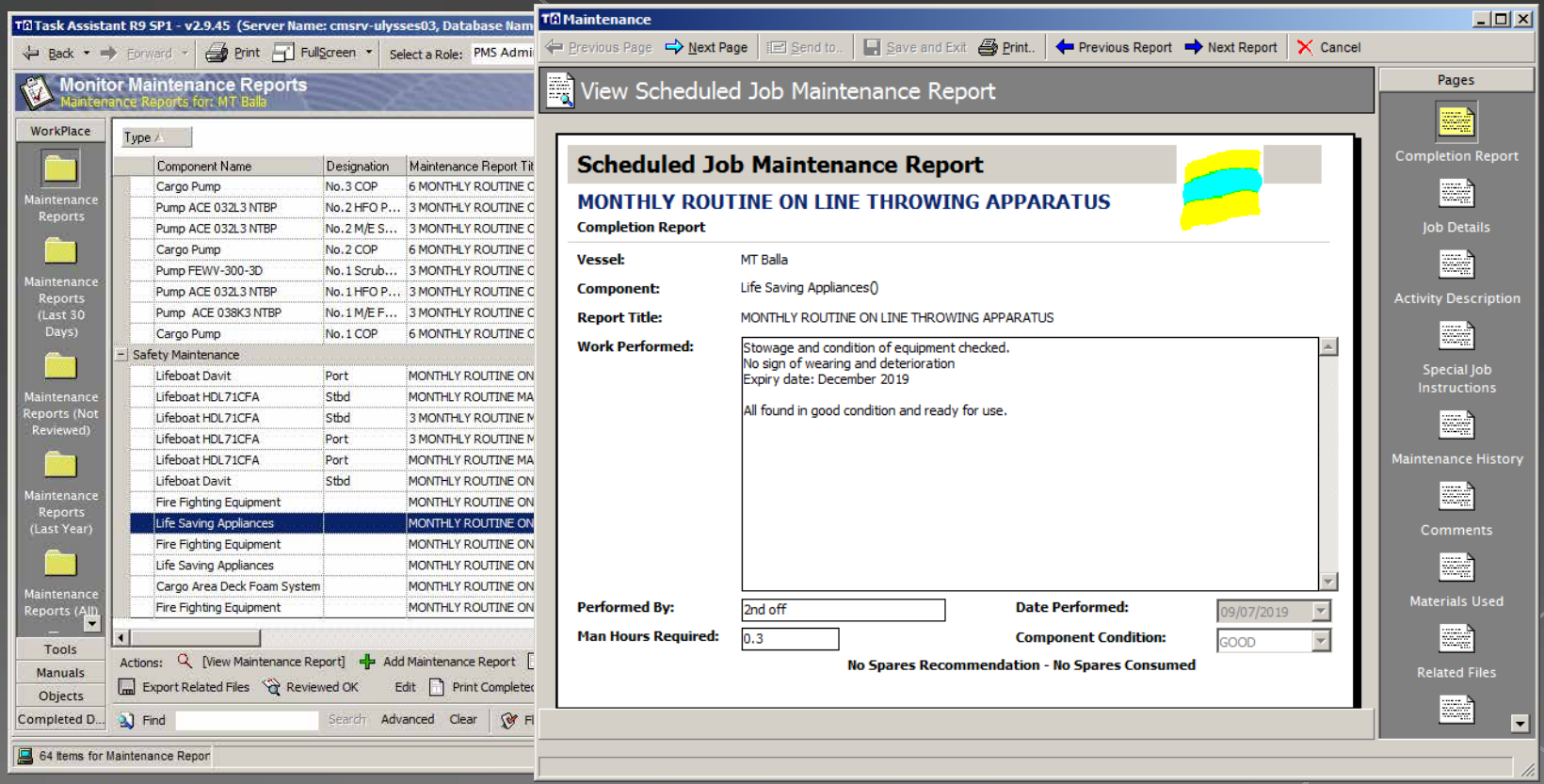
Dry-docking scheduling is practically ready with the click of a button



Planned Maintenance

Modern PMS Systems

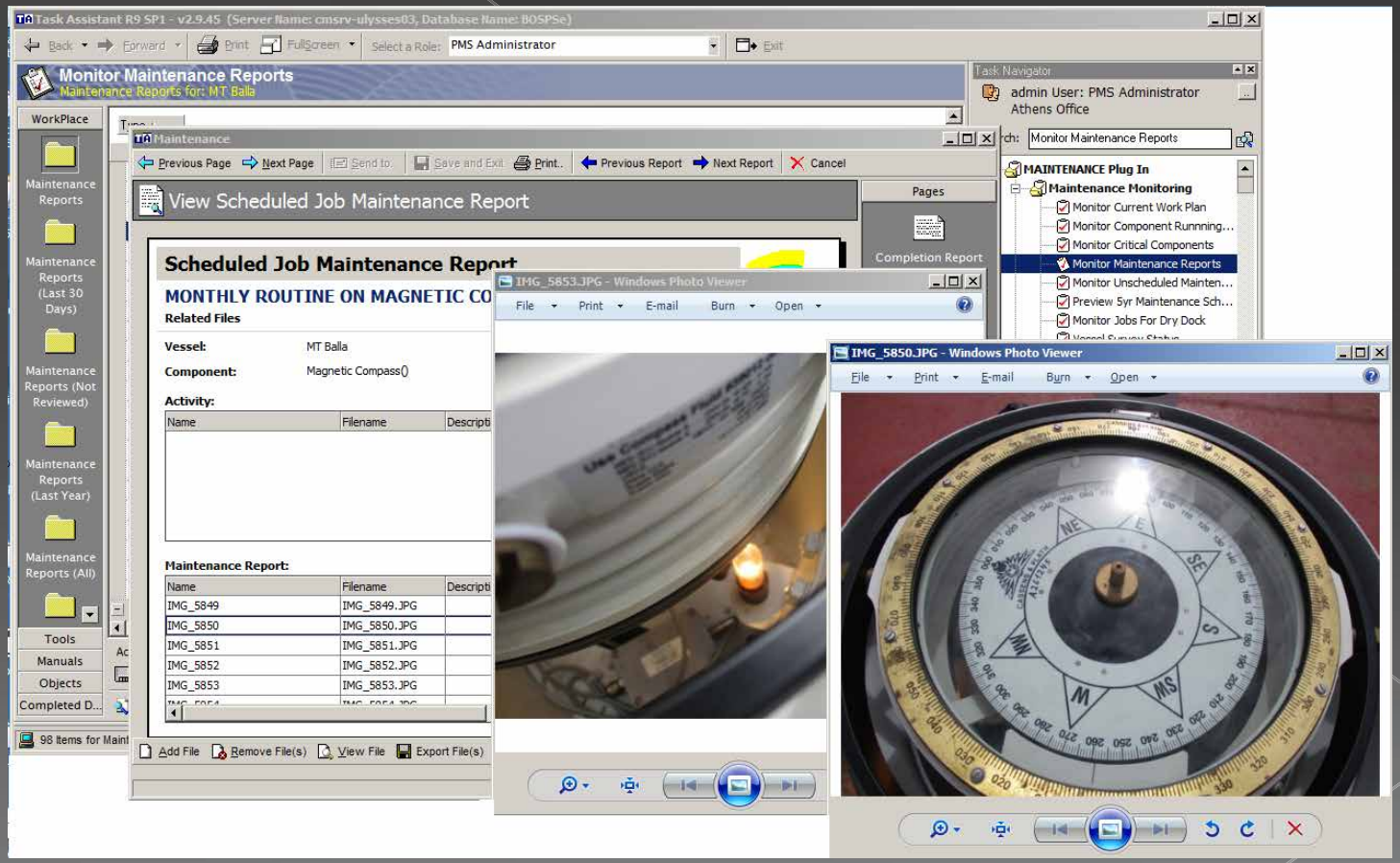
Maintenance reporting made simple & consistent



Planned Maintenance

Modern PMS Systems

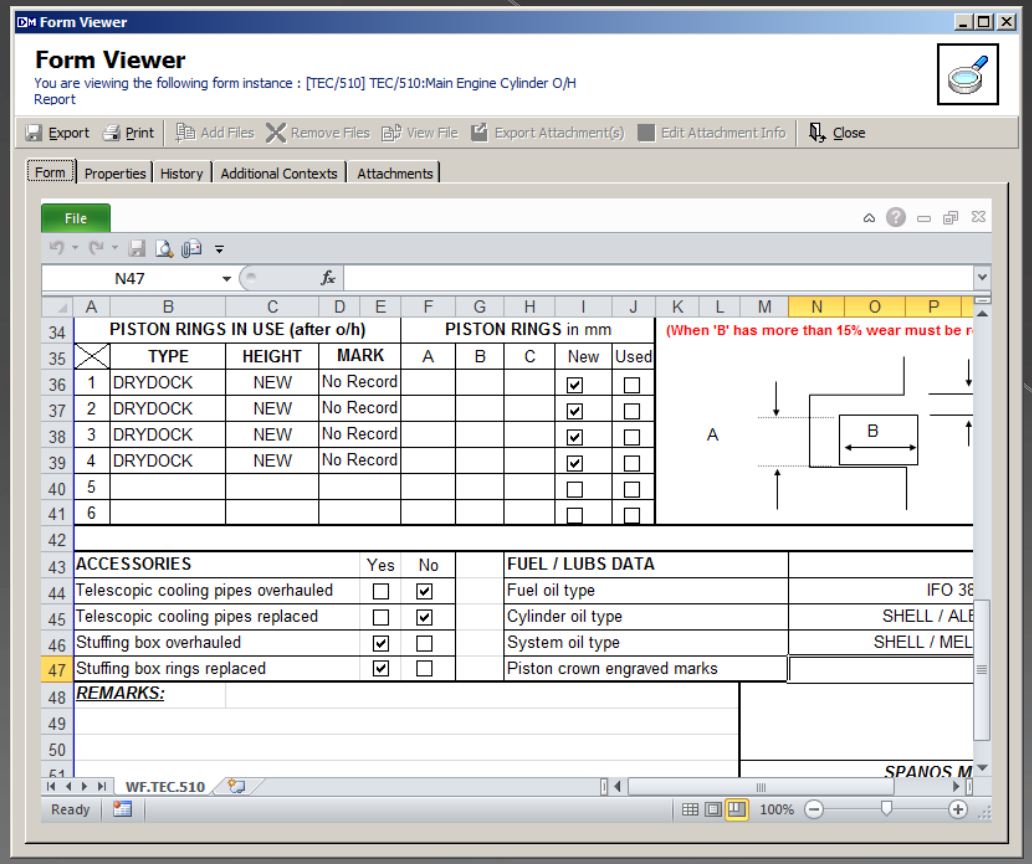
With clear evidence that maintenance is actually carried out



Planned Maintenance

Modern PMS Systems

Measurements and calibrations during overhauling service are reported within the planned maintenance activity



Planned Maintenance

Maintenance KPIs

- KPIs are measured on a quarterly and annual basis.
- Targets are set based on previous year performance

			Target	
	KPI	Actual 2ndQuarter	Short Term	Long Term
1	Maintenance Outstanding PMS Activities KPI– 12 Month running Average	2.71%	3%	3%
2	Critical machinery failures per vessel (YTD)	2.37	2.5 Defects/Ship	2 Defects/Ship
3	Critical machinery defects over all defects KPI (YTD)	8.16%	15%	10%
4	Critical defects over all unscheduled jobs (YTD)	1.80%	2.5%	2%
5	Unscheduled jobs as a percentage of all jobs (YTD)	2.69%	2.5%	2%
6	Rescheduled Jobs (YTD)	1.56%	2.5%	2%
7	M/E Performance Monitoring - Engines not meeting optimal running conditions	8.9%	5%	3%
8	Lub oil analysis results	1.2%	3%	2.5%
9	Stoppage days over total operating days	0.342%	0.15%	0.12%

Performance monitoring & analysis

Monitoring of Key Performance Indicators enable management to evaluate the efficiency of the fleet and take appropriate actions and measures when the targets are not met.

Performance monitoring & analysis

Thank you for your attention!