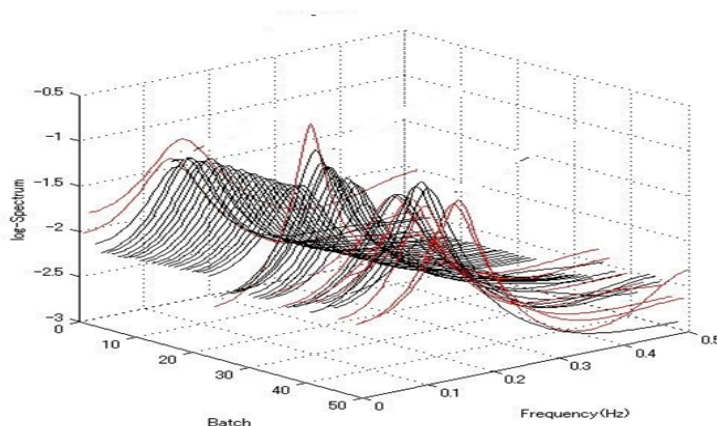


日本海事協会 業界要望による共同研究
平成25.10 ~ 27.9.30

「船体運動を考慮した 機関・船体情報統合型 船載モニタリングシステムの開発」

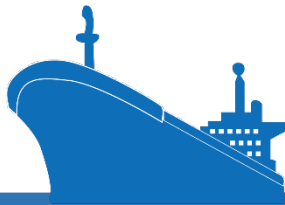
報告書2 (プロトタイプ構成)



一般社団法人 日本船舶機関士協会

株式会社大津海事研究所、日本無線株式会社、

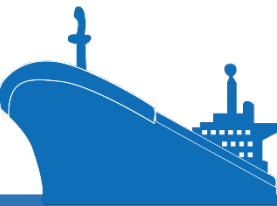
JRCS株式会社、インテグレーションテクノロジー株式会社



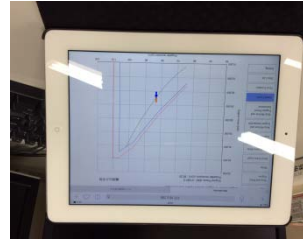
目的

プロジェクトで試作した船体・機関モニタリングシステムの外観
および 画面構成を示す。

プロトタイプの外観



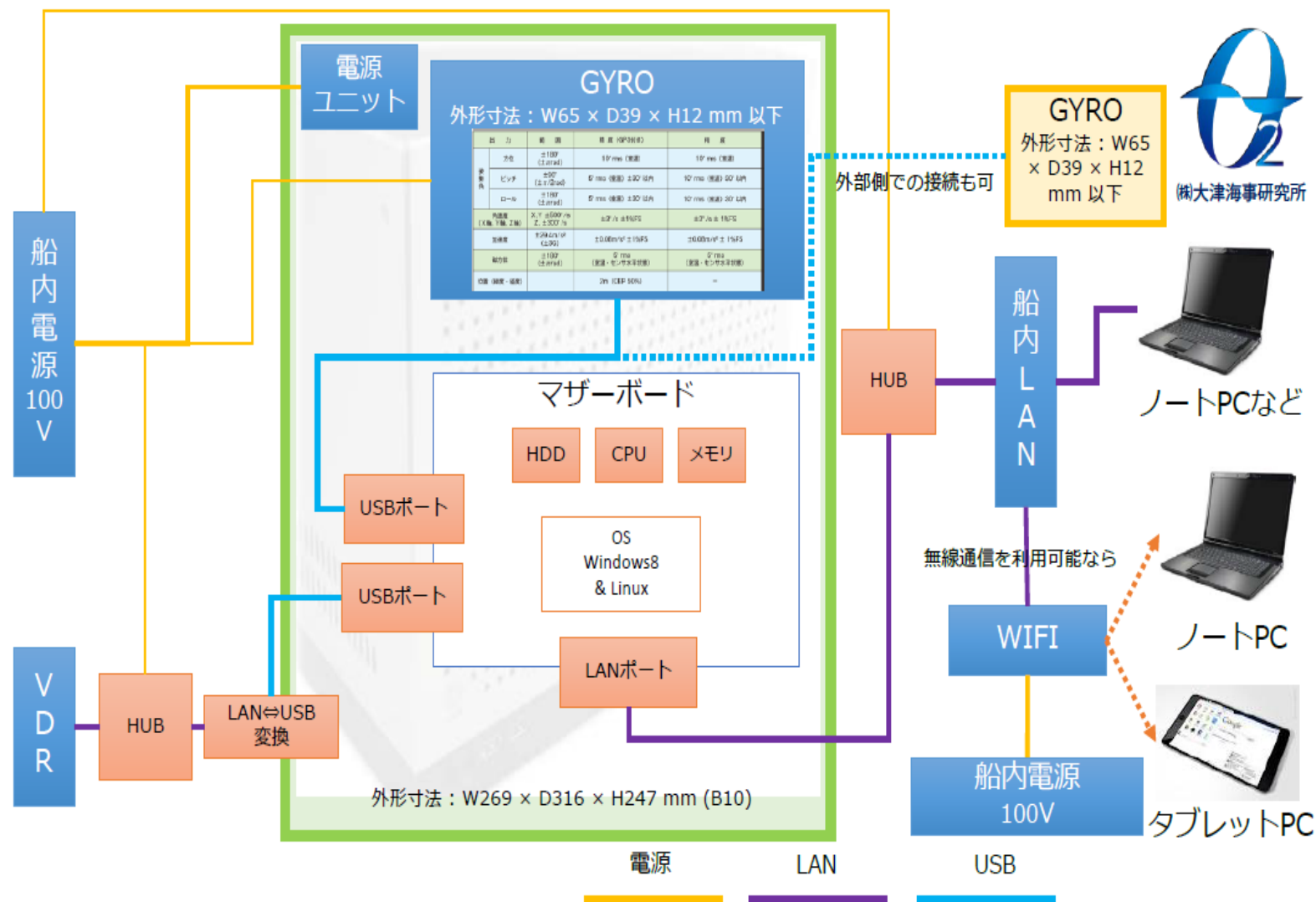
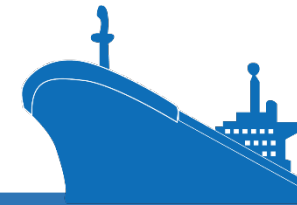
CPU、VDR接続、機関情報収集機能
運動計測ジャイロ内臓、LAN対応



IPAD, Windows対応、
海洋ブロードバンド接続可能



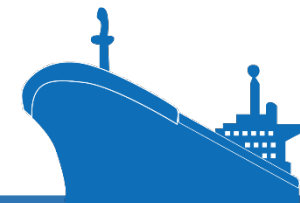
船体・機関モニタリングシステムの構成



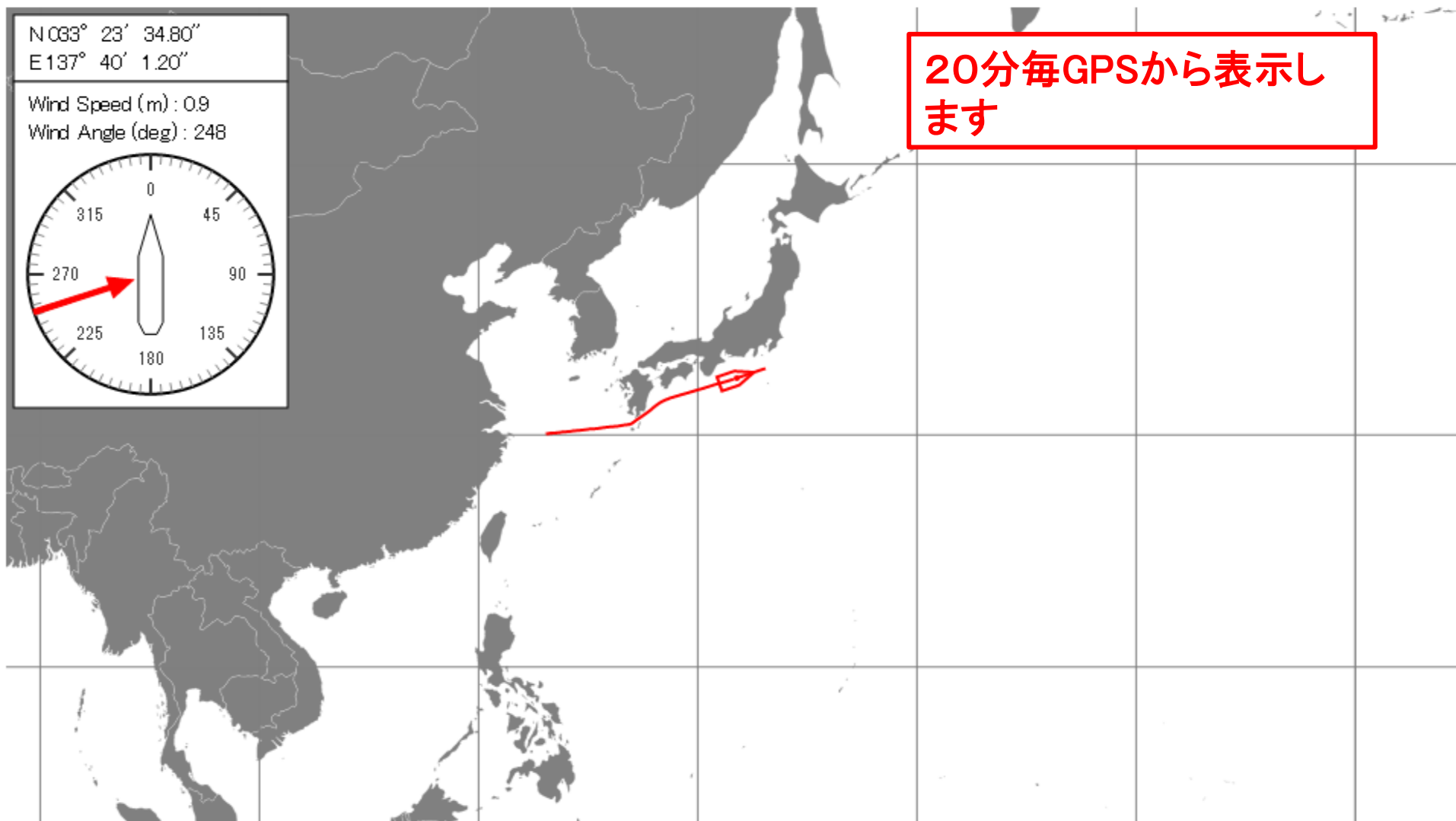
船載型モデルベースモニタリングシステムの機能

メニュー	日本語名	内容
MAP	本船位置	本船位置の海図上プロット
Time Series	船体・機関運動時系列表示(1s毎)	船首揺、縦揺等の1秒毎時系列表示
Ship and Main Engine	船体・機関運動メータ表示(60s毎)	60秒ごと実舵角、トルクの円グラフ表示
Short Term (20 min) Logger	短期航海記録(20分毎)	Log速力、実舵角等の20分平均表示
Roll-Pitch Monitor	横揺、縦揺周期モニター	横揺、縦揺周期表示、GM値
Contribution to Rolling	横揺への船体運動影響	横揺れへの船体運動表示、GM値
Contribution to Engine Power	機関出力への船体運動影響	機関出力への船体からの影響
Engine Load Diagram	機関性能曲線図	rpm－機関出力曲線他
Fuel Oil Motion	燃料消費量モニター(20分毎)	20分毎燃料消費量に関する時系列表示
Latest Data Logger	データロガー履歴	データロガーの20分、1時間、4時間、1日前値

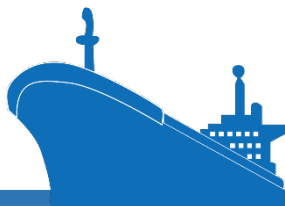
Map・・・本船位置



- Map
- Time Series
- Ship and Main Engine
- Short Term (20min) Logger
- Roll Pitch Monitor
- Contribution to Rolling
- Contribution to Engine Power
- Engine Load Diagram
- Fuel Oil Motion
- Latest Data Logger
- Setting



Time Series...船体・機関運動時系列表示(1秒毎)



Map

Time Series

Ship and Main
Engine

Short Term
(20min) Logger

Roll Pitch Monitor

Contribution to
Rolling

Contribution to
Engine Power

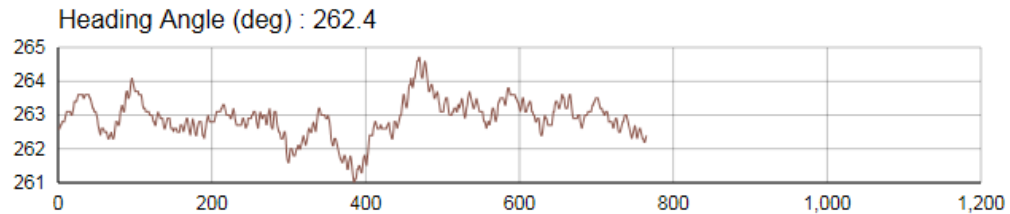
Engine Load
Diagram

Fuel Oil Motion

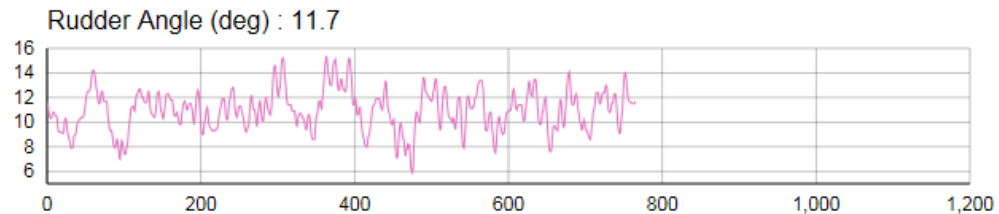
Latest Data
Logger

Setting

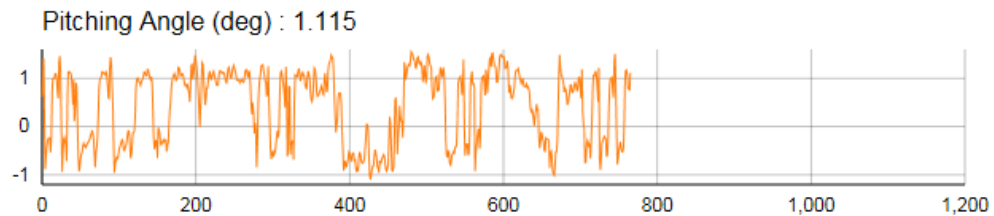
船首方位



実舵角



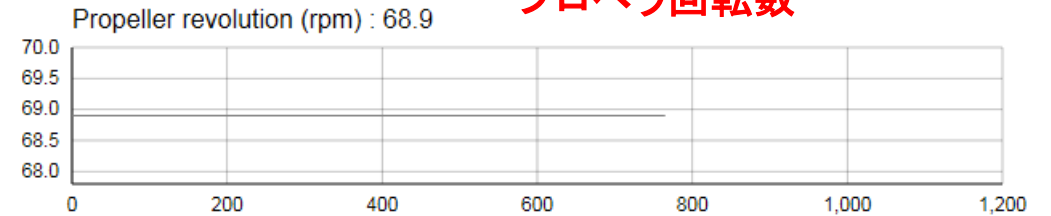
縦揺れ



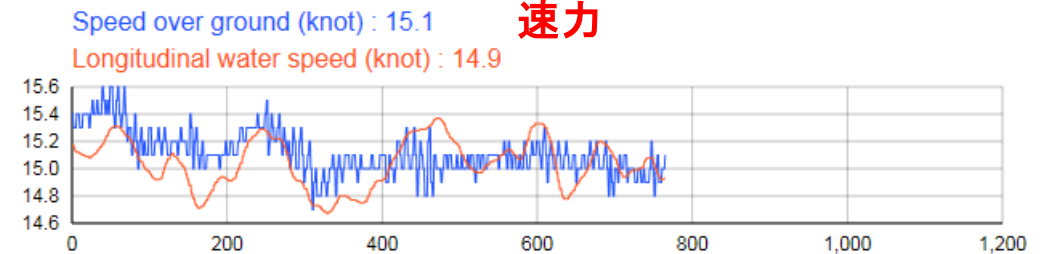
横揺れ



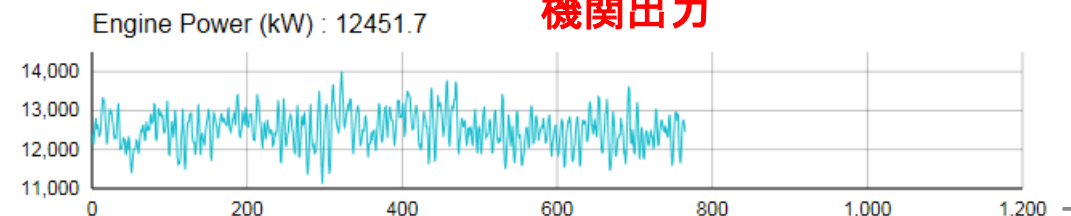
プロペラ回転数



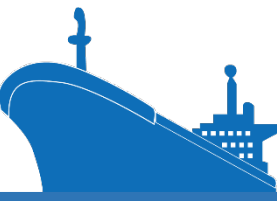
速力



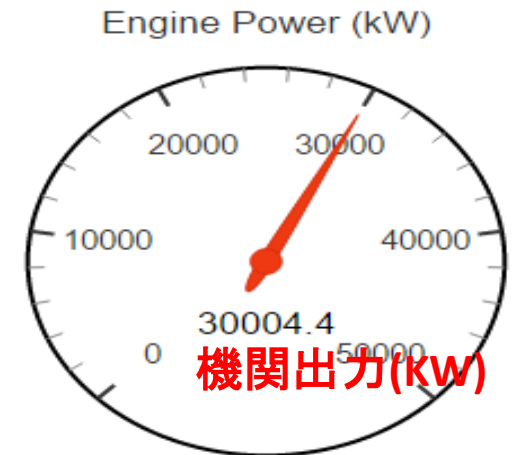
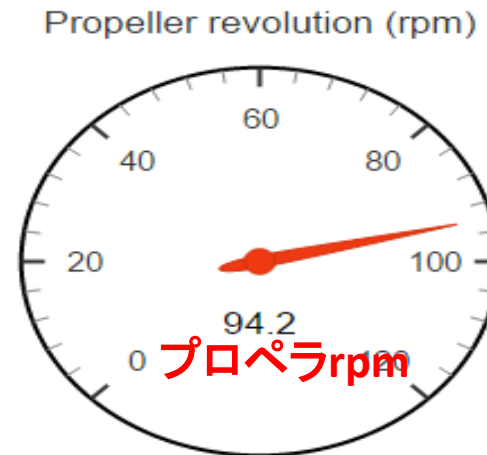
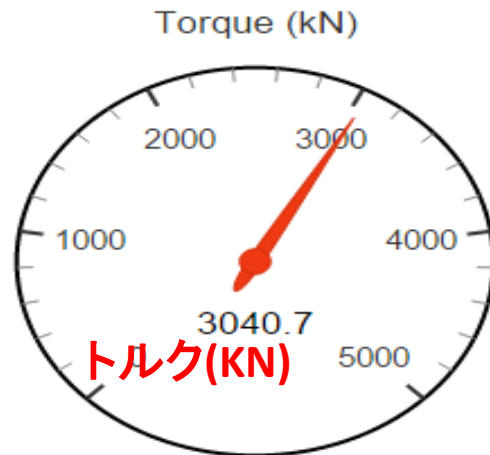
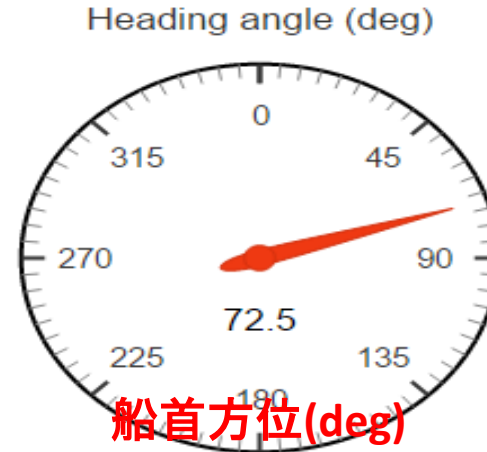
機関出力



Ship and Main Engine ... 船体・機関運動メータ表示(60秒毎)

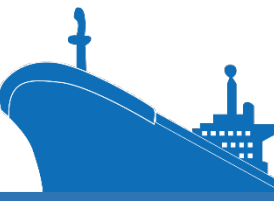


Map
Time Series
Ship and Main Engine
Short Term (20min) Logger
Roll Pitch Monitor
Contribution to Rolling
Contribution to Engine Power
Engine Load Diagram
Fuel Oil Motion
Latest Data Logger
Setting

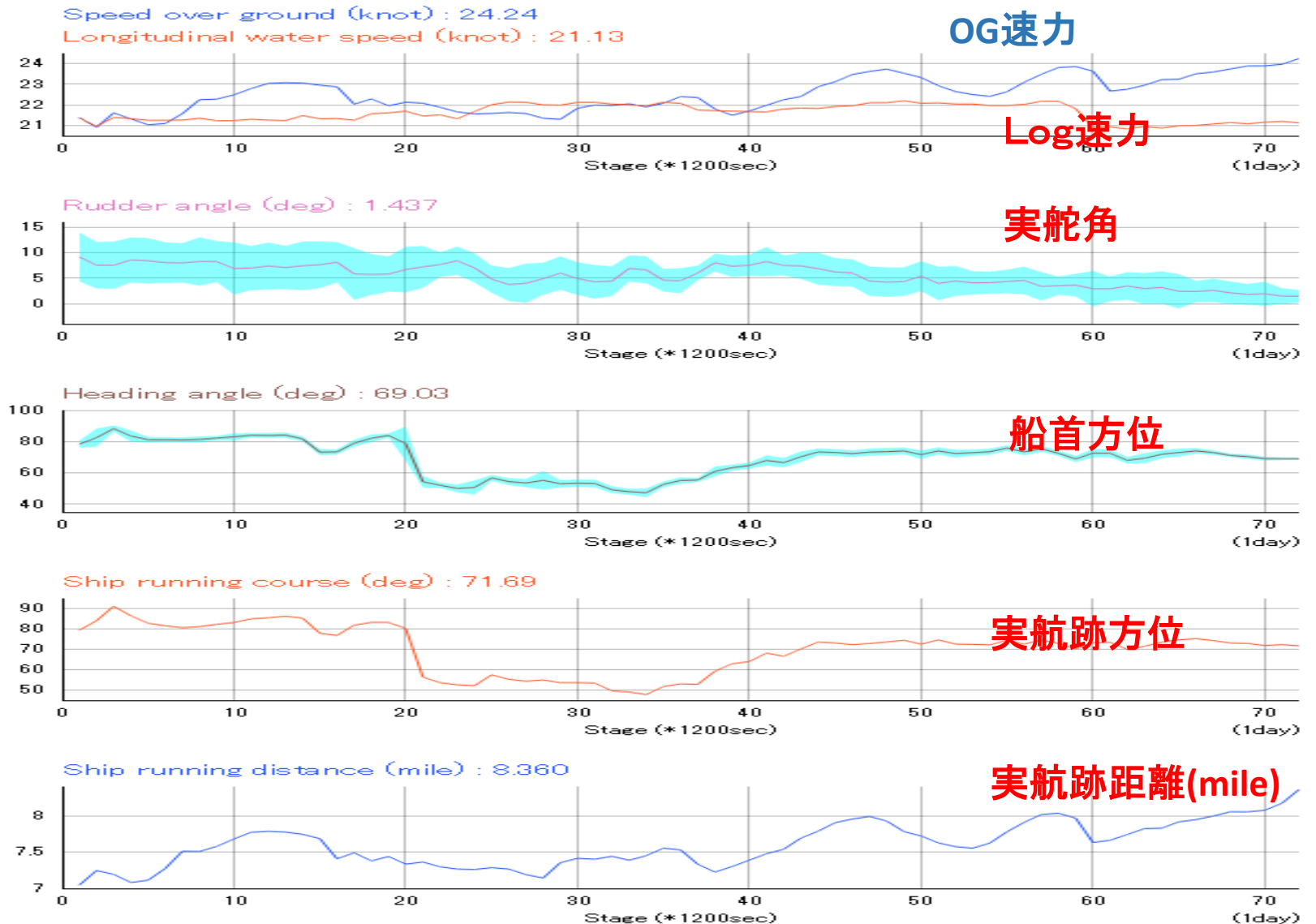


Update interval 60sec

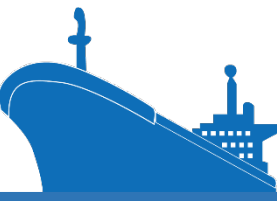
Short Term (20min) Logger ··· 短期航海記録(20分毎)



Map
Time Series
Ship and Main Engine
Short Term (20min) Logger
Roll Pitch Monitor
Contribution to Rolling
Contribution to Engine Power
Engine Load Diagram
Fuel Oil Motion
Latest Data Logger
Setting



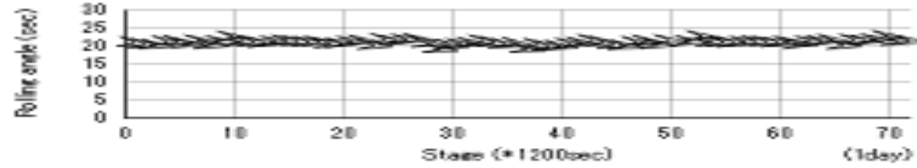
Roll-Pitchモニター・・・横揺、縦揺周期モニター



- Map
- Time Series
- Ship and Main Engine
- Short Term (20min) Logger
- Roll Pitch Monitor**
- Contribution to Rolling
- Contribution to Engine Power
- Engine Load Diagram
- Fuel Oil Motion
- Latest Data Logger
- Setting

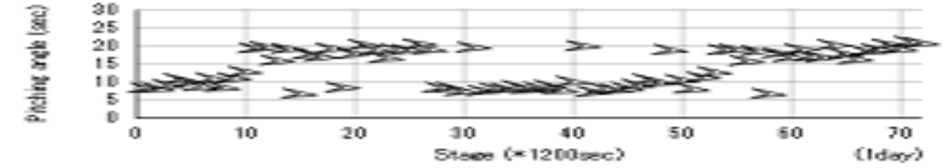
Rolling Period

1200秒毎の横揺れ周期



Pitching Period

1200秒毎の縦揺れ周期



Pitching Period vs Rolling Period

Pitching angle (sec) : 20.61
Rolling angle (sec) : 21.36

縦揺れ周期



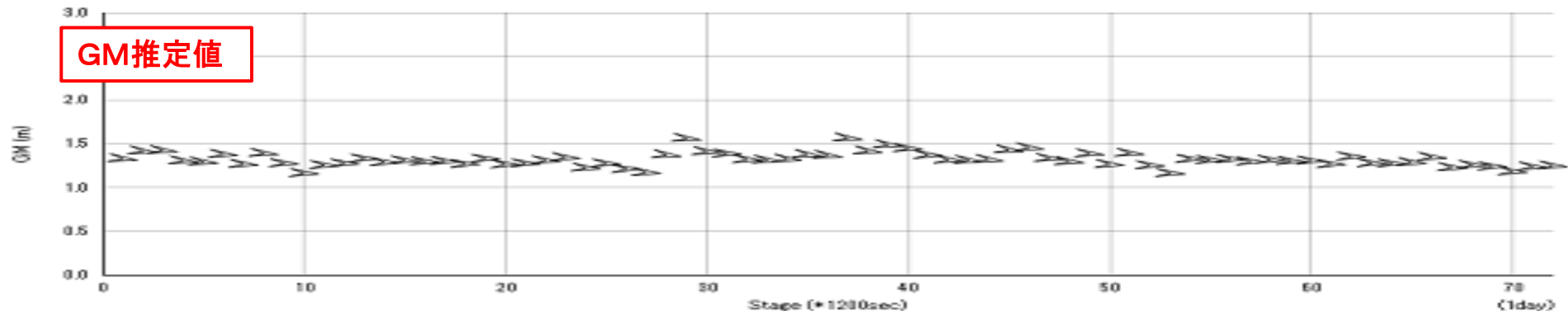
この線上に点が来ると船体・機関がビート現象を起こす。

横揺・縦揺同調現象
横揺れ周期=縦揺れ周期

パラメトリック横揺れ
横揺れ周期=縦揺れ周期の2倍

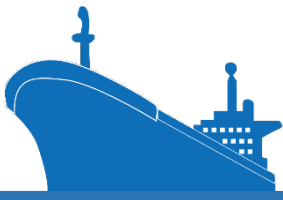
横揺れ周期

GM Value



GM推定値

操縦性能への横揺れ・舵の影響



Map

Time Series

Ship and Main Engine

Short Term (20min) Logger

Roll Pitch Monitor

Contribution to Yaw

Contribution to Engine Power

Engine Load Diagram

Fuel Oil Motion

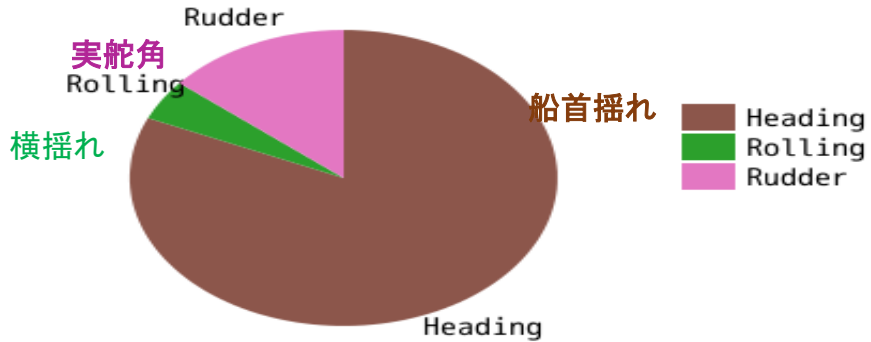
Latest Data Logger

Setting

Setting

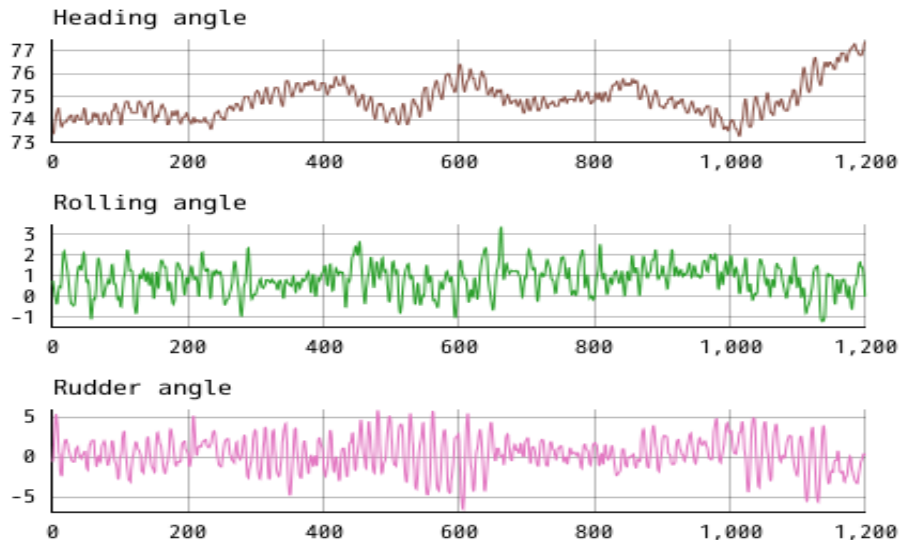
Contribution to Yaw

船首揺れへの横揺れ、舵からの影響

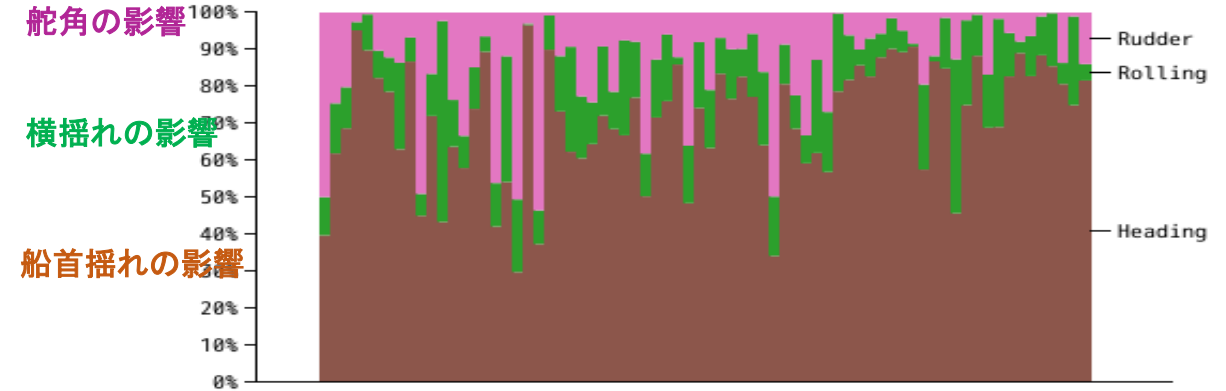


20分毎表示

Latest Time History



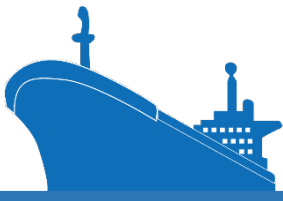
History of Contribution to Yaw



Yaw-Heel-Rudder Effect

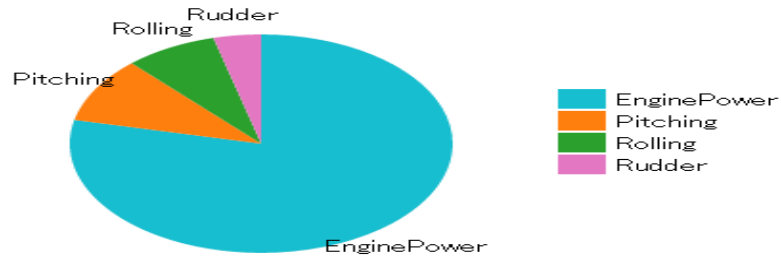
船首揺運動への横揺、実舵角が20分間でどの程度影響したかを次々と表示

機関出力への船体運動影響

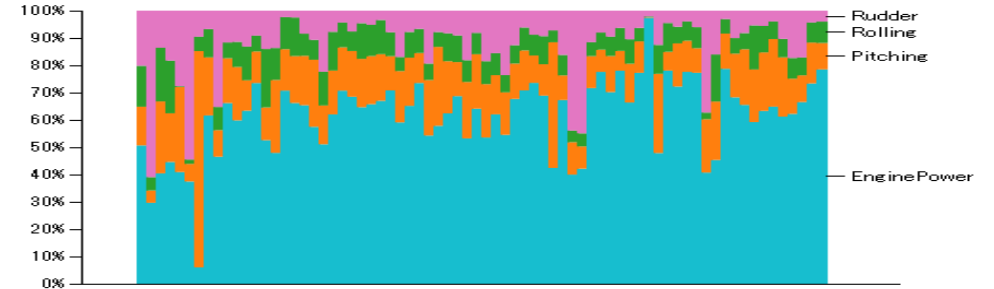


- Map
- Time Series
- Ship and Main Engine
- Short Term (20min) Logger
- Roll Pitch Monitor
- Contribution to Rolling
- Contribution to Engine Power
- Engine Load Diagram
- Fuel Oil Motion
- Latest Data Logger
- Setting

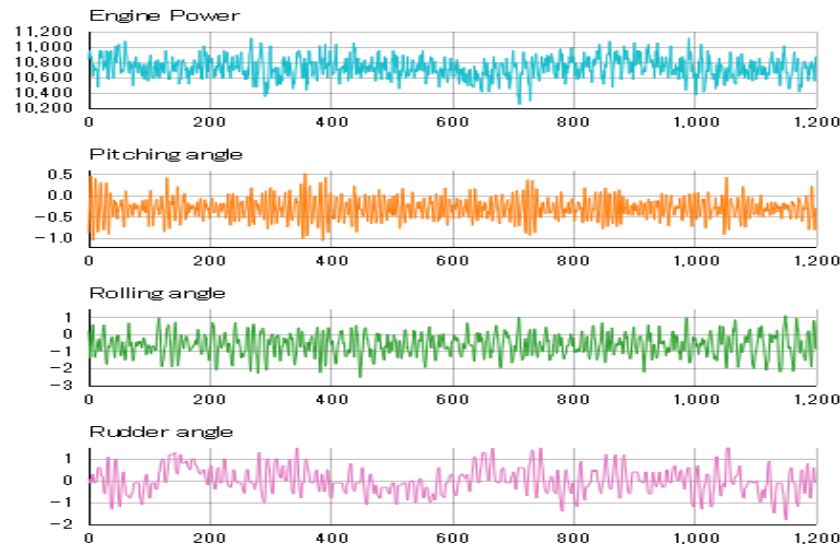
Contribution to Engine Power



History of Contribution to Engine Power



Latest Time History



機関出力

縦揺れ

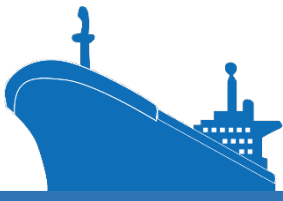
横揺れ

実舵角

機関出力への船体運動の影響度

機関出力への縦揺れ、横揺れ、
実舵角の影響の度合いを表示

Engine Load Diagram(1)

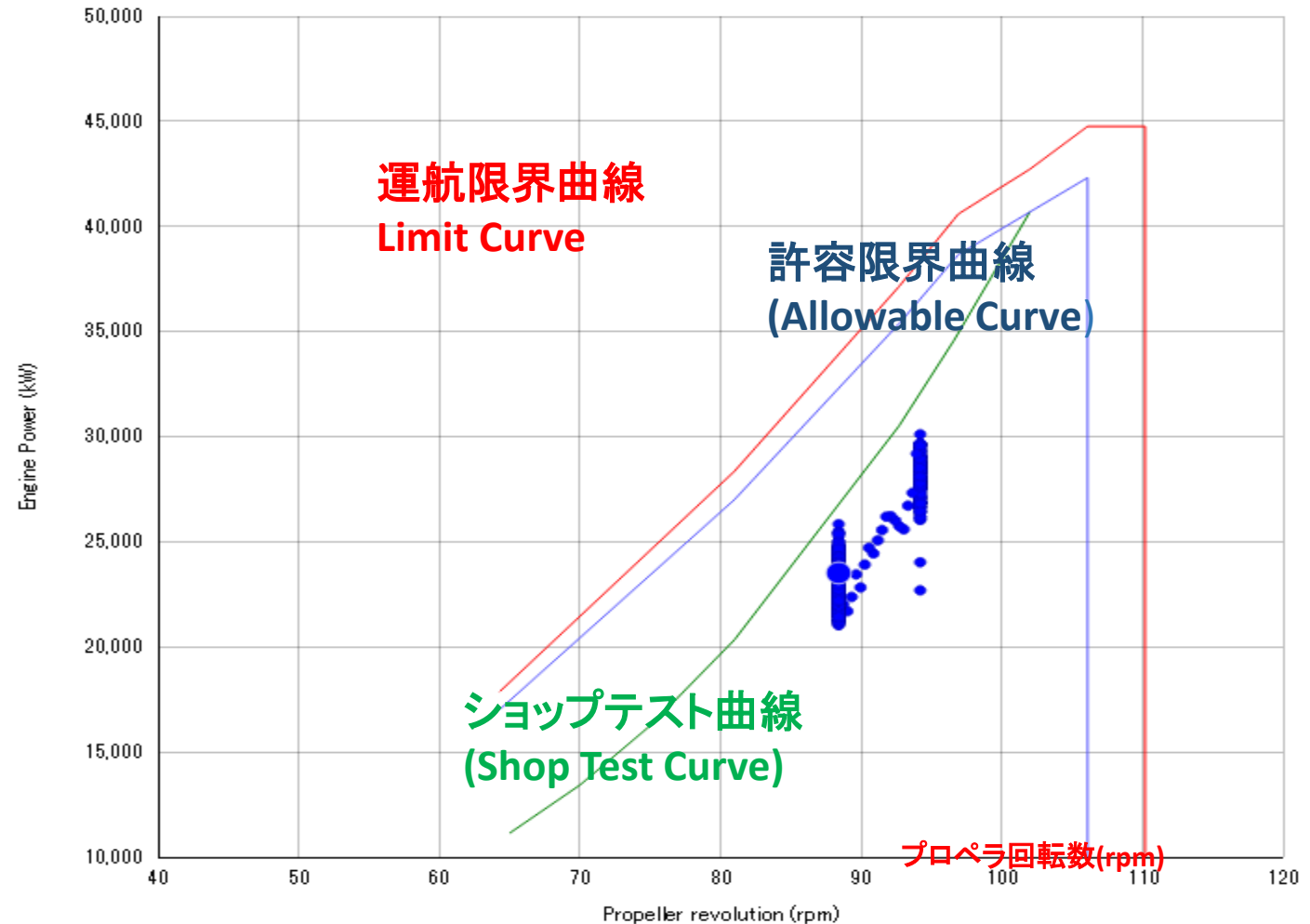


機関出力-プロペラ回転数曲線(20秒毎)

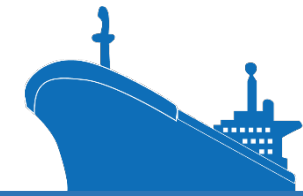
- Map
- Time Series
- 機関出力(KW)
- Short Term (20min) Logger
- Roll Pitch Monitor
- Contribution to Rolling
- Contribution to Engine Power
- Engine Load Diagram
- Fuel Oil Motion
- Latest Data Logger
- Setting

Engine Power vs Engine Speed (Update interval 20sec)

Engine Power (kW) : 23512.1
Propeller revolution (rpm) : 88.40

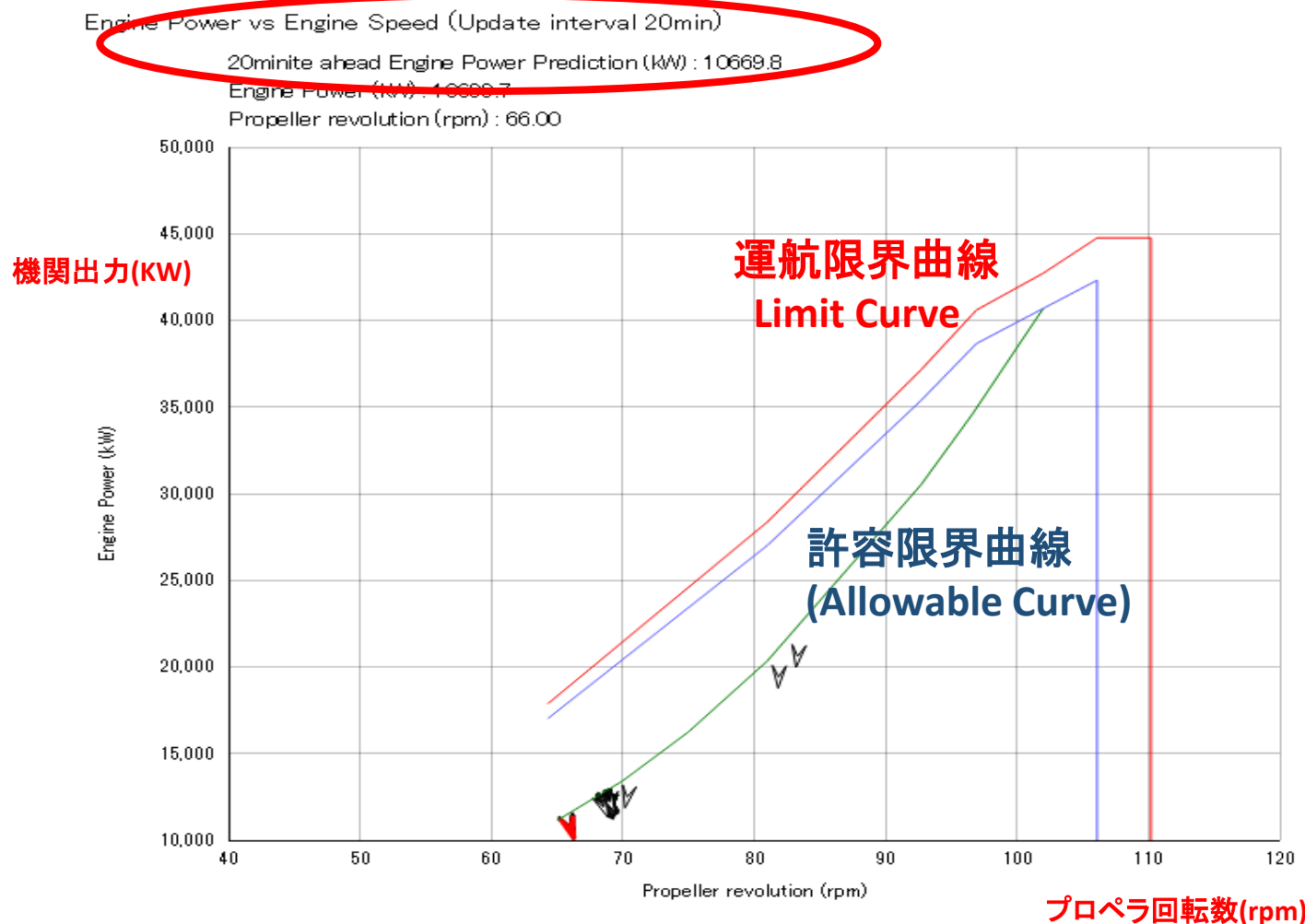


Engine Load Diagram(2)

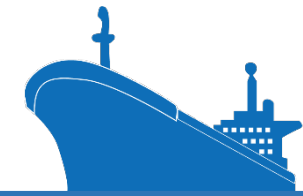


機関出力-プロペラ回転数曲線(20分毎)

20分先の機関出力予測値



Engine Load Diagram(3)



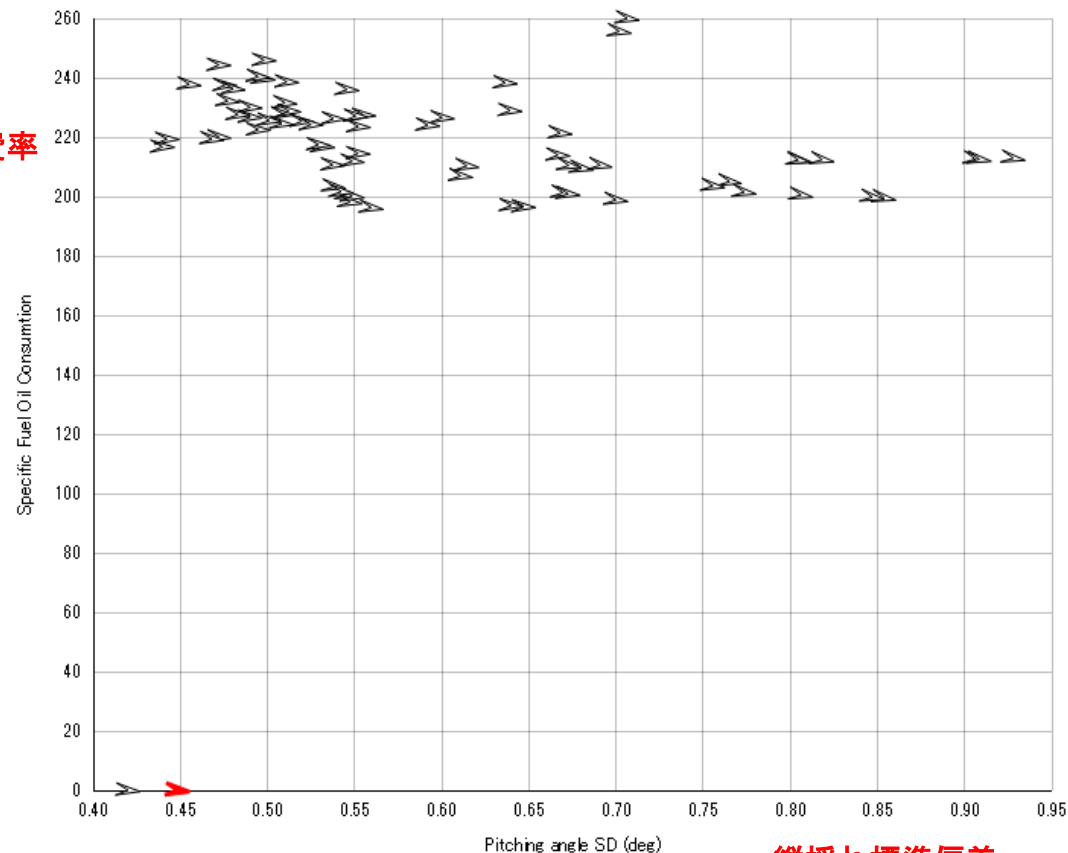
燃料消費率-縦揺れ標準偏差

SFOC vs Pitching angle SD

Specific Fuel Oil Consumption : NaN

Pitching angle SD (deg) : 0.448

燃料消費率



縦揺れ標準偏差

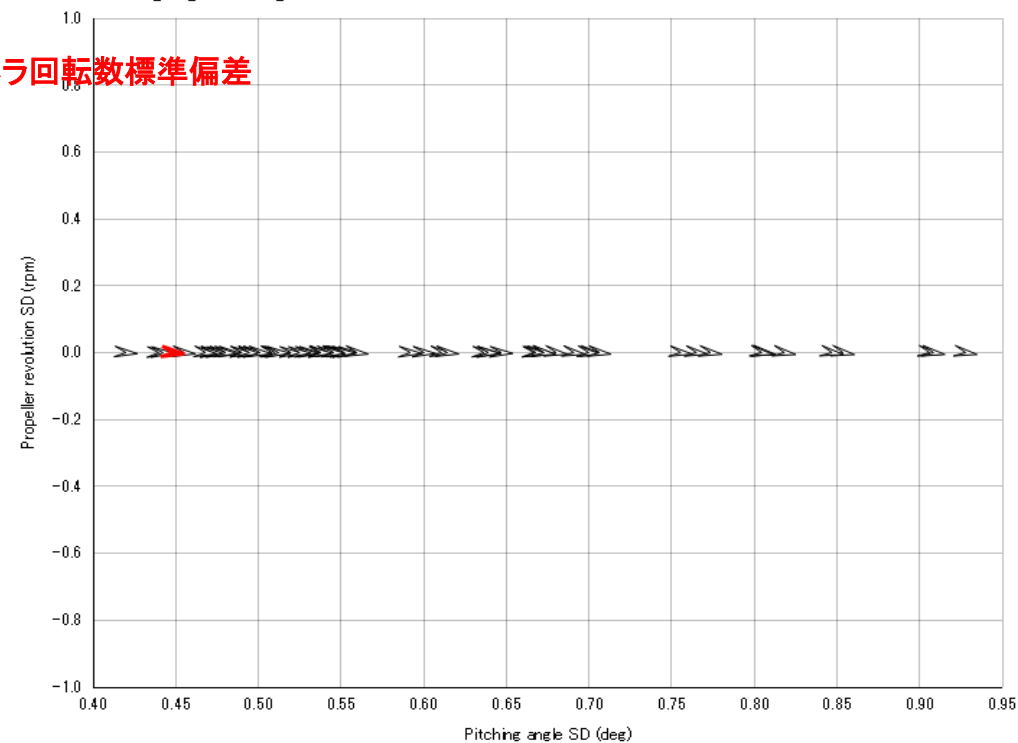
プロペラ回転数-縦揺れ標準偏差

Engine Speed SD vs Pitching angle SD

Propeller revolution SD (rpm) : 0.000

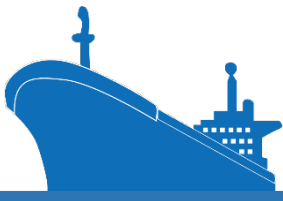
Pitching angle SD (deg) : 0.448

プロペラ回転数標準偏差



縦揺れ標準偏差

Engine Load Diagram(4)

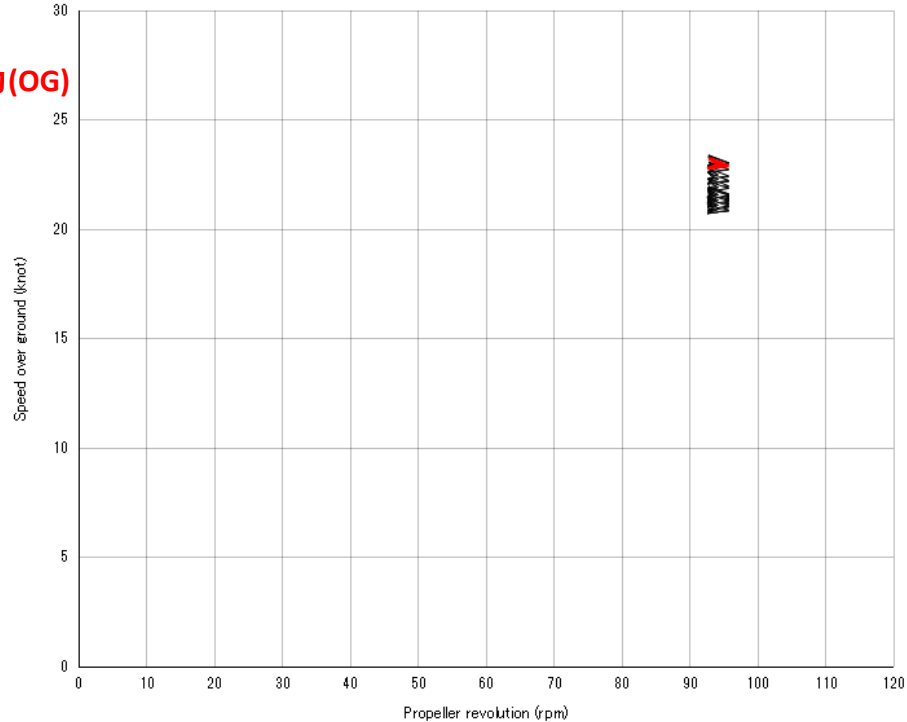


プロペラ回転数-速力(OG)

Ship Speed vs Engine Speed

Speed over ground (knot) : 22.95
Propeller revolution (rpm) : 9420

速力(OG)



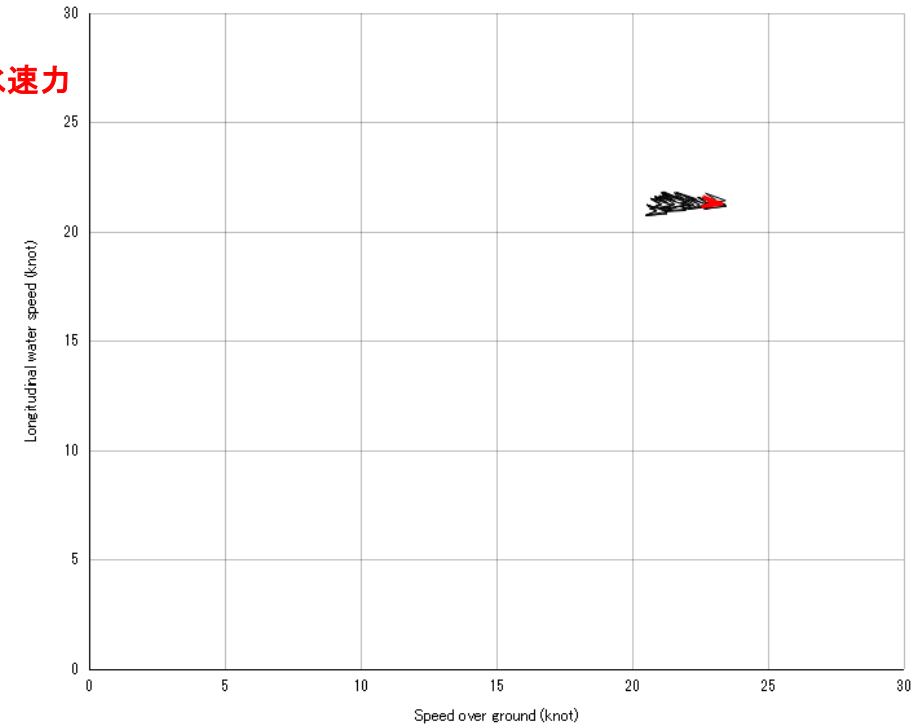
プロペラ回転数(rpm)

対水速力-対地速力

Longitudinal water speed vs Ship Speed

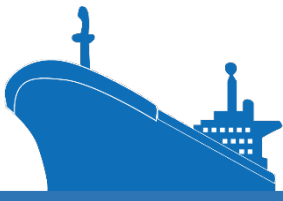
Longitudinal water speed (knot) : 21.33
Speed over ground (knot) : 22.95

対水速力



対地速力

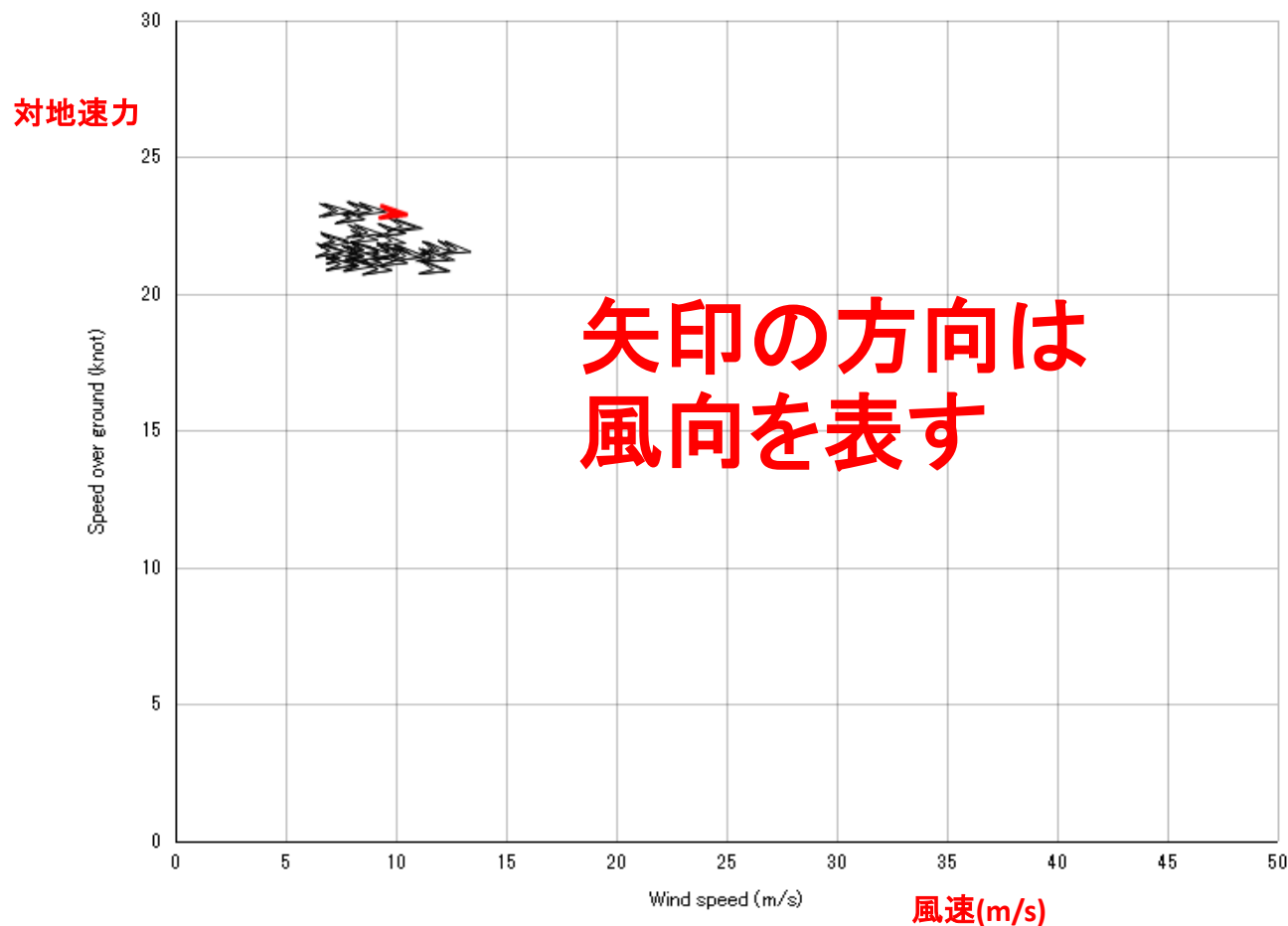
Engine Load Diagram(5)



Ship Speed vs Wind Speed

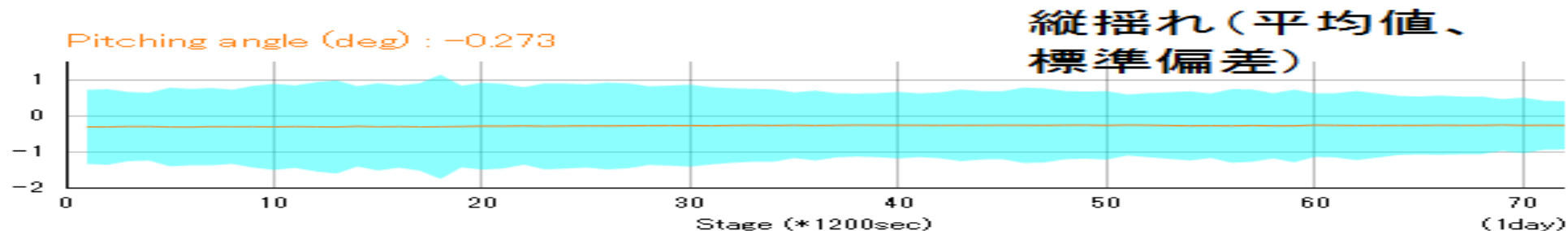
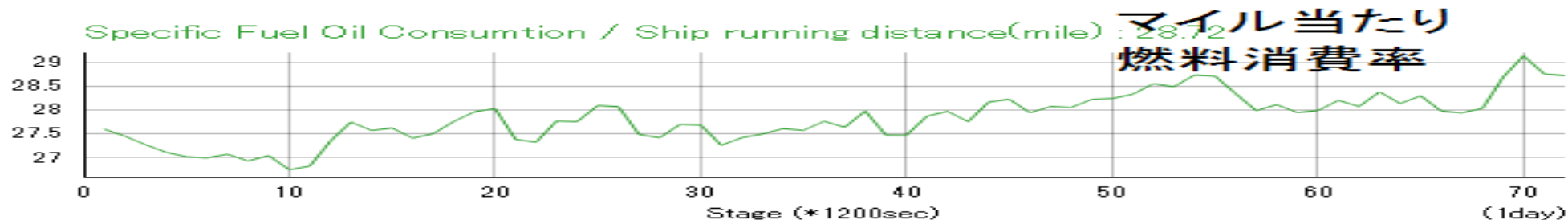
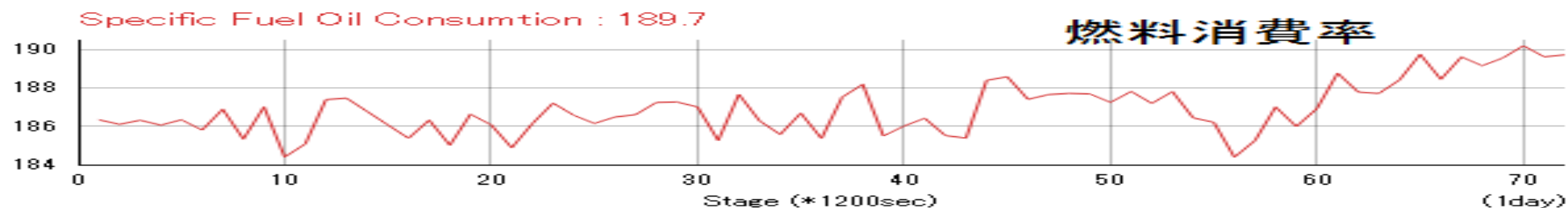
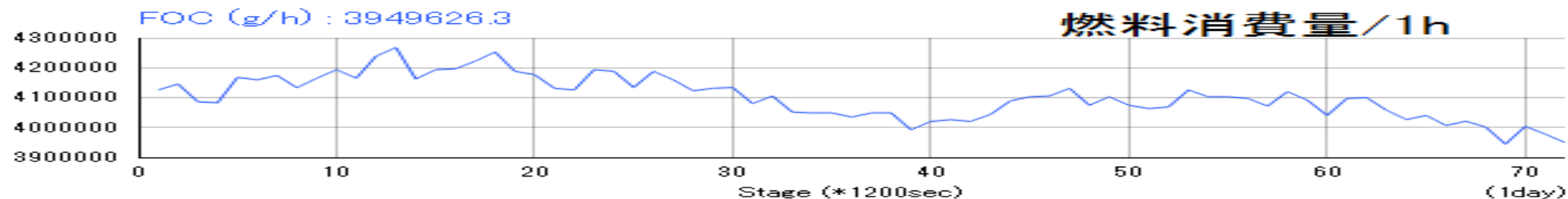
Speed over ground (knot) : 22.95

Wind speed (m/s) : 9.896

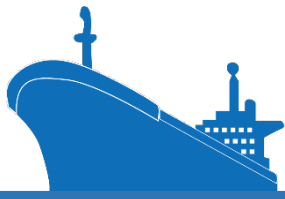


対地速力に対する
風向・風速の
影響を知る

Fuel Oil Motion 燃料消費量モニター(20分毎)



Latest Data Logger(1)・・・データロガー履歴



InitialSet

Exec

← 20分前

← 1時間前

← 4時間前

	BatchMean	BatchSD	BatchMax	BatchMin	HourMean	HourSD	HourMax	HourMin	WatchMean
Latitude(deg)	55.2199	0	0	0	55.2199	0	0	0	55.2199
Longitude(deg)	-175.1919	0	0	0	-175.1919	0	0	0	-175.1919
LogSpeed(knots)	21.5538	0.1106	0	0	21.5538	0.1106	0	0	21.6343
OGSpeed(knots)	22.0853	0	0	0	22.0853	0	0	0	22.2228
Running Distance(miles)	18.9448	0	0	0	18.9448	0	0	0	76.2372
Drift Distance(miles)	-0.8915	0	0	0	-0.8915	0	0	0	-0.4440
Pitching(deg)	-0.4312	0.3198	0	0	-0.4312	0.3198	0	0	-0.4275
Rolling(deg)	2.7915e+03	0	0	0	2.7915e+03	0	0	0	2.7915e+03
HeadingCo(deg)	90.7663	0	0	0	90.7663	0	0	0	90.7663
ActualRudder(deg)	2.2478	0	0	0	2.2478	0	0	0	2.2478
Torque(KNm)	3.0979e+03	0	0	0	3.0979e+03	0	0	0	3.0979e+03
Thrst(KN)	2.7915e+03	0	0	0	2.7915e+03	0	0	0	2.7915e+03
Power(KW)	3.0597e+04	403.2143	0	0	3.0597e+04	403.2143	0	0	3.0608e+04
PropellerRPM	94.3518	0.3484	0	0	94.3518	0.3484	0	0	94.3509
Slip	0.1235	0	0	0	0.1235	0	0	0	0.1202
SeaMarge	54.8949	0	0	0	54.8949	0	0	0	53.0473
FOConsumption(gr)	5.3968e+03	0	0	0	5.3968e+03	0	0	0	2.1599e+04
Specific FO Consumption(SFOC)	176.3867	0	0	0	176.3867	0	0	0	176.4228
ShoptestResult	171.7100	0	0	0	171.7100	0	0	0	171.7109
Difference	4.6768	0	0	0	4.6768	0	0	0	4.7119
Percent	2.6514	0	0	0	2.6514	0	0	0	2.6708
Condition(0:good,:1:not good)	0	0	0	0	0	0	0	0	0
FOConsumtion/Mile	2.0877	0	0	0	2.0877	0	0	0	0
WindDirection(deg)	263.9242	0	0	0	263.9242	0	0	0	263.3444
WindSpeed(m/sec)	11.8390	0	0	0	11.8390	0	0	0	11.4180
WindDirectionClass	7	0	0	0	7	0	0	0	7
WindForceClass	7	0	0	0	7	0	0	0	6

航走距離、航路偏差等

スリップ

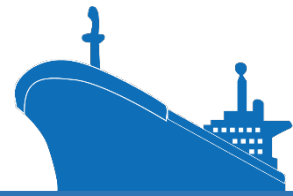
シーマージン

ショップテストと比較し燃料消費率が10%以内ならばエンジンの状態良好

Specific FO Consumption(SFOC)

ショップテストと比較し燃料消費率が10%以内ならばエンジンの状態良好

Latest Data Logger(2)・・・データロガー履歴



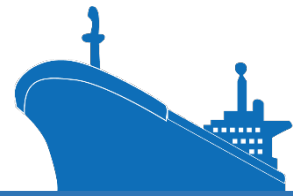
4時間前

1日前

4hour before				1Day before			
Mean	SD	Min	Max	Mean	SD	Min	Max
30.190	0.000	30.053	30.800	30.061	0.000	30.003	30.800
170.082	0.000	-164.202	170.687	173.256	0.000	-164.202	177.268
15.559	0.116	15.090	19.980	16.651	0.118	15.090	20.410
15.522	0.095	14.900	20.000	16.743	0.103	14.900	20.900
5.207	0.000	5.062	6.634	5.615	0.000	5.062	6.883
-0.291	0.288	-1.602	1.251	-0.275	0.368	-2.625	2.145
-0.465	0.675	-3.072	2.493	-0.602	0.933	-5.812	3.362
285.737	0.000	261.200	287.700	272.943	0.000	261.200	287.700
0.293	0.760	-4.600	4.300	-0.231	0.961	-6.600	9.900
1559.406	22.436	1467.896	2812.557	1688.959	30.597	1426.989	2812.557
1393.614	128.278	1143.373	2572.955	1512.145	177.595	1096.622	2581.721
10781.271	155.116	10148.599	24512.717	12327.898	240.914	9865.775	24512.717
66.000	0.000	66.000	83.300	69.235	0.075	66.000	83.300
2090334.955	0.000	2057495.445	3957970.464	2380012.204	0.000	2054717.880	3957970.464
193.884	0.000	189.074	196.603	193.281	0.000	188.537	202.098
189.168				186.096			
4.717				7.185			
2.433				3.717			
good				good			
37.248	0.000	28.500	38.839	34.584	0.000	27.394	38.839
341.821	0.000	320.500	353.400	268.819	0.000	0.000	359.900
15.187	0.632	10.900	21.200	12.540	0.654	0.000	21.200

Setting

初期設定画面



運航計画

出港日時	(Departure Date & Time)		(UTC)
仕向け入港予定日時	(Arrival Date & Time)		(UTC)
仕向け港までの距離	(Distance to Destination Port)		(nm)
計画船速	(Planned Speed)		(knot)
出港時の排水量	(Displacement ton @Departure)		(ton)
計画主機関回転数	(Planned RPM of Main Engine)		(rpm)
予測主機関出力	(Estimated Output of Main Engine)		(kW)
主機関燃料予測消費量	(Estimated Fuel Consumption)		(MT)

使用燃料油性状

比容量	(Specific Gravity)	
真発熱量	(Low Calorific Value)	(MJ)

主要目

全長	(Length)	267	(m)
幅	(Breadth)	35.04	(m)
喫水	(Draft)	10	(m)