Introduction of NIIGATA remote monitoring system from the point of features and advantages with some specific applications

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IHI Power Systems Co., Ltd.

Contents

1. Motivation of Development

2. Introduction of NIIGATA Remote monitoring system

3. Remote monitoring system functions
   (Data analysis and diagnosis)

4. Summary

NIIGATA

1. Motivation of Development

2. Introduction of NIIGATA Remote monitoring system

3. Remote monitoring system functions
   (Data analysis and diagnosis)

4. Summary

NIIGATA

1. Motivation of development

●Maritime industry issues and solutions

Issues		Solutions	
Environment	Global warming	Environmental regulations	GHG emission reduction
	Air pollution		NOx regulation
			SOx regulation
Cost	Expensive maintenance	Economical operation	Optimized maintenance
	Loss because of trouble		Preventive maintenance
	Increase in fuel prices		Low BSFC operation
Manpower	Succession of skills	Operation support	Systemized skills
	Decrease in crews		Utilization of ICT
	Aging and skill decline		

1. Motivation of development

●Activities for solutions

Solutions	
Environmental regulations	GHG emission reduction
	NOx regulation
	SOx regulation
Economical operation	Optimized maintenance
	Preventive maintenance
	Low BSFC operation
Operational support	Systemized skills
	Utilization of ICT

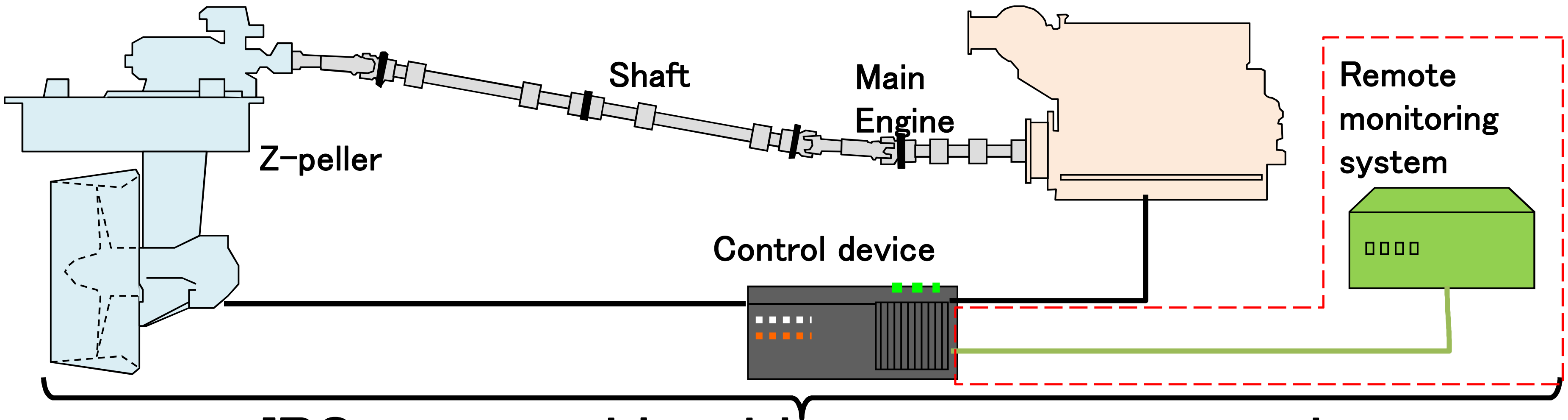
<u>**Point of remote monitoring system**</u>

- Accumulation and using big data
  - Review of optimized operation with past data
- Remote monitoring
  - Support from land office
- Failure prediction
  - Diagnose device health with monitoring data
- Fault diagnosis
  - Identifying the cause of failure

1. Motivation of development

Product lineup of IPS engines and azimuth thrusters

Category of Engine	Typical Model	Azimuth thruster	Ship type
High Speed Diesel Engine	20FX	Not installed	Patrol boat
Medium Speed Diesel Engine	28AHX 28AHX-DF	NIIGATA Z-peller ™	Tug boat Supply vessel
Low Speed Diesel Engine	34RT	Not installed	Ferry Cargo ship



IPS can provide with an one− stop service

1. Motivation of Development

2. Introduction of NIIGATA Remote monitoring system

3. Remote monitoring system functions
   (Data analysis and diagnosis)

4. Summary

2.Introduction of NIIGATA remote monitoring system

●History of development

1996

- Remote monitoring system for land power plant :Start of operation

2009

- Remote monitoring system for marine :Start of development

2011

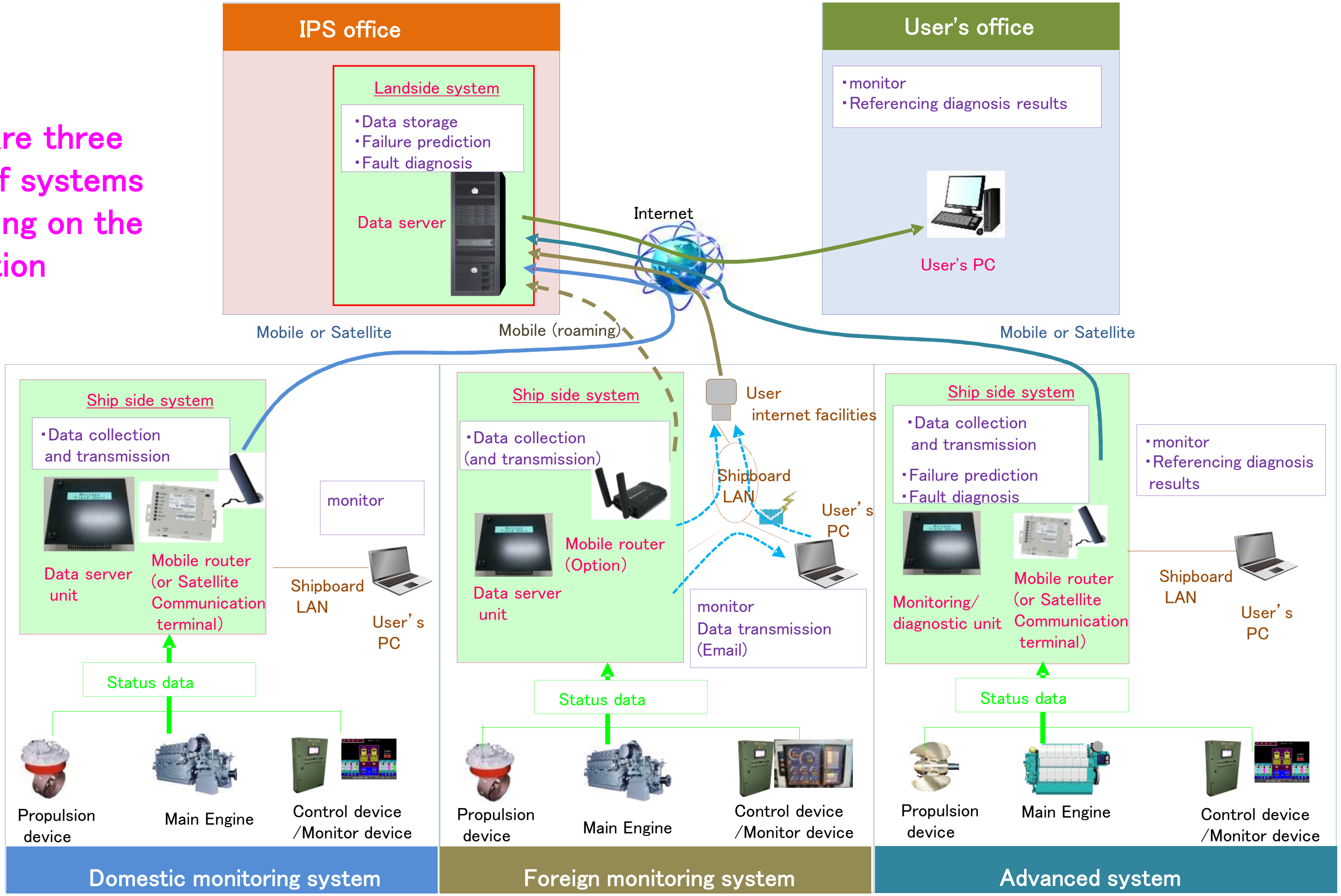
- Remote monitoring system for domestic ships：Start of operation
  →Compatible with domestic communications
  Delivery record　Tug boat：10 ships
  Other：2 ships
  （August 2019）

2018

- Remote monitoring system for foreign ships：Start of operation
  →Compatible with foreign communications
  Delivery record　Tug boat：4 ships
  （August 2019）

●NIIGATA Remote monitoring system

There are three types of systems depending on the application



2. Introduction of NIIGATA remote monitoring system

●Lineup

Type	Ship side			Communication method				Land side			
	Display monitoring data	Failure prediction	Fault diagnosis	Mobile	Satellite	User internet facilities	Mobile (roaming)	Display monitoring data	Storage and summarize	Failure prediction	Fault diagnosis
Domestic monitoring system	○			○	○			○	○		
Foreign monitoring system	○					○	○	○	○		
Advanced system	○	○	○	○	○	○	○	○	○	○	○

1. Motivation of Development

2. Introduction of NIIGATA Remote monitoring system

3. Remote monitoring system functions
(Data analysis and diagnosis)

4. Summary

3. Remote monitoring system functions (Data analysis and diagnosis)

●Data display

Current operation data

Numerical style

Analog data is displayed.

Panel style

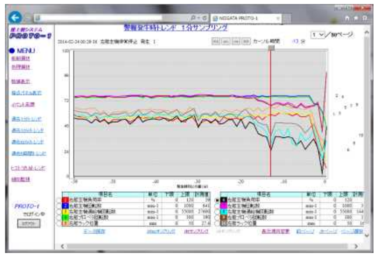
Digital data is displayed.

Past operation data

Historical table

Alarms and operation events are displayed.

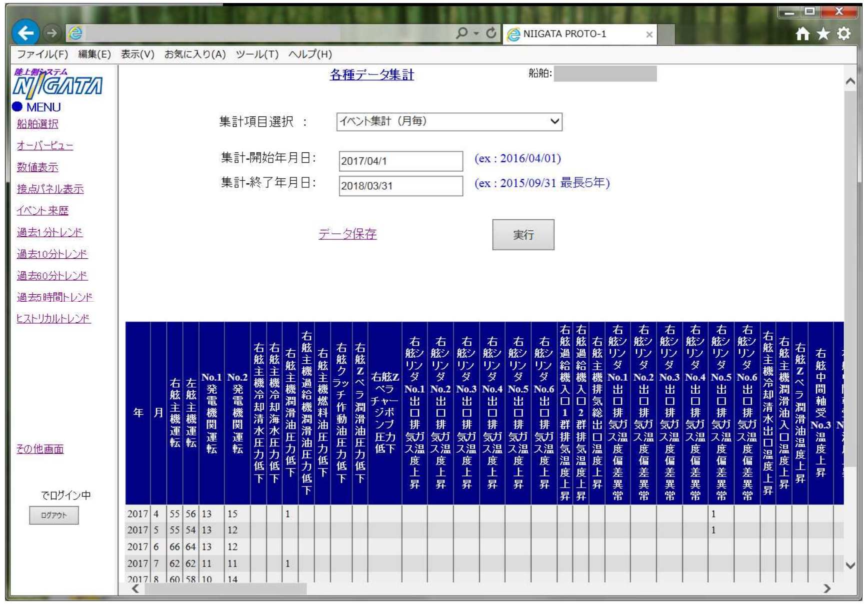
Trend graph



Operation data is displayed with trend graph.

●Summarized data

Operation data	Operation event

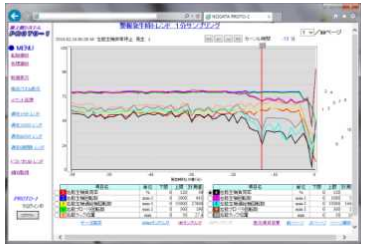


This function displays aggregated engine operation time (overall and each load-zone),fuel consumption, alarm events, etc. with daily and monthly.

3. Remote monitoring system functions (Data analysis and diagnosis)

●Advantages of data display functions

Past operation data



Current operation data

Summarized data

IPS and customer can get the operation status and tendency exactly and rapidly

《Experienced effects》

- Grasping the trend of fuel consumption with past operation data and exact estimation of fuel consumption for future operation.
- Quick response to troubles by sharing the accurate situation of trouble between crew on ship and support engineer on land.
- Contribution for new ship building in point of system configuration with preferable specification equipment based on analysis of stored monitoring data.

3. Remote monitoring system functions (Data analysis and diagnosis)

● A Failure prediction and failure diagnosis

- Our purpose of failure prediction is to avoid serious trouble in advance by detecting abnormal tendency with big data of past monitoring data.
- The failure diagnosis provides analyses case of trouble with monitoring data and serves useful information to crew for quick recovery.

● Explanation of each function

Failure prediction

- This system can quickly find abnormal signs.
- This function is intended to prevent serious failure.

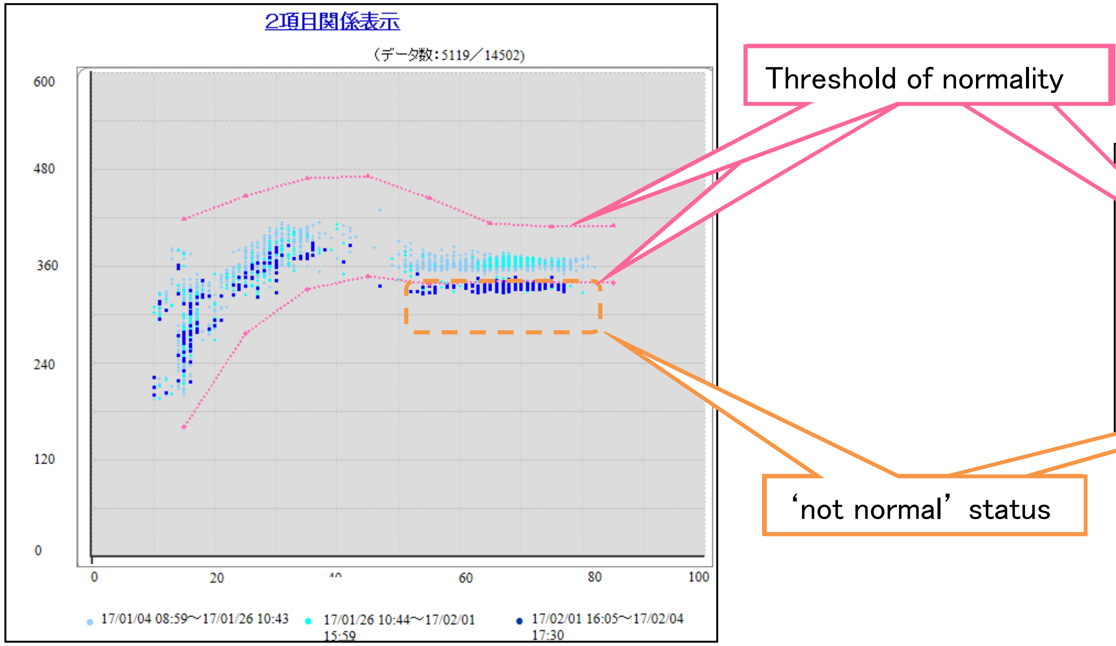
Failure diagnosis

- This function informs the cause of failure and how to deal.
- This assists in fast recovery.

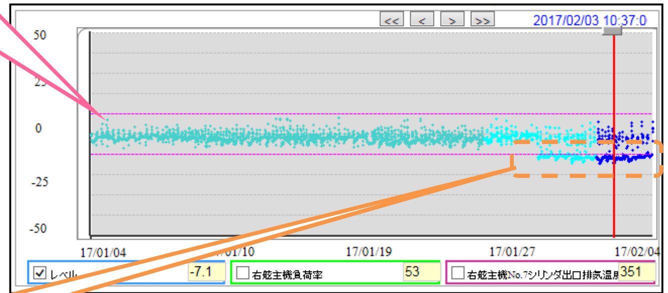
3. Remote monitoring system functions (Data analysis and diagnosis)

●Failure prediction function

- ☐ Our failure prediction detects ‘not normal’ status before reaching into failure focusing on operation data which has deep relation to failure.
- ☐ Following left side figure shows two parameters correlation and right side figure shows normality of trend operation data.



[Two parameter correlation]

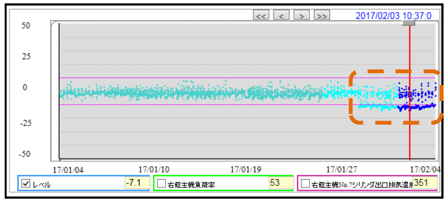


[Normality of trend operation data]

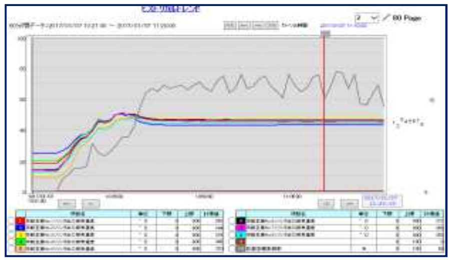
3. Remote monitoring system functions (Data analysis and diagnosis)

●Failure diagnosis function

- ☐ Failure diagnosis function supports quick recovery by deriving the candidates of failure cause and checking elements.
- ☐ This function has internal diagnostic matrix like the center of following figure, and shows possible failure cause and related manual for procedure of inspection, dismantle and parts replacement.

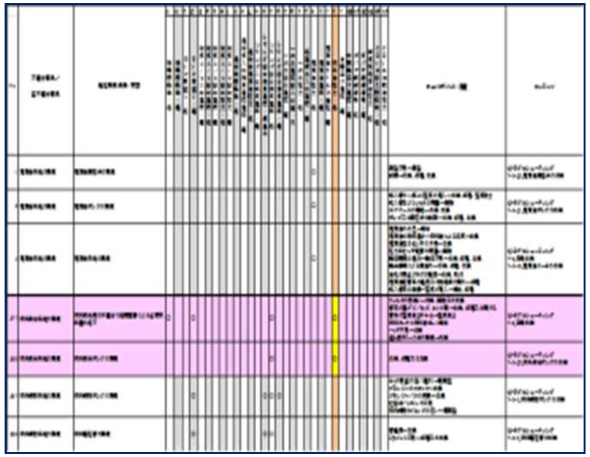


Failure prediction results



Operation data

Detect ‘not normal’ status

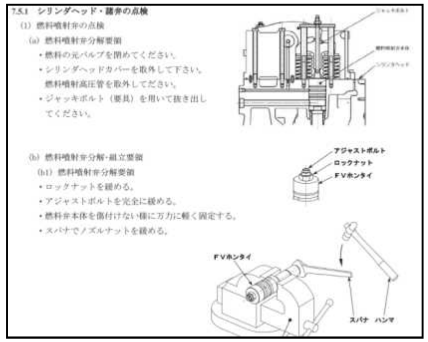


Internal diagnostic matrix

Diagnostic

Checkpoints

[Diagnosis result]

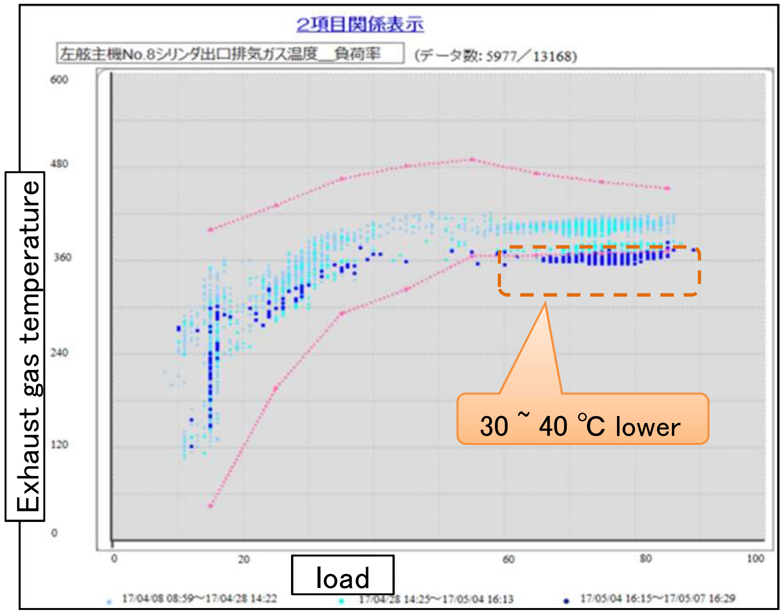


[Related manuals]

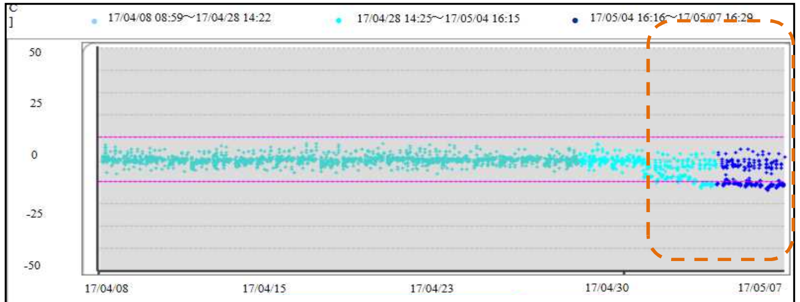
3. Remote monitoring system functions (Data analysis and diagnosis)

●Example "Main Engine cylinder No.7 exhaust gas temperature lower"

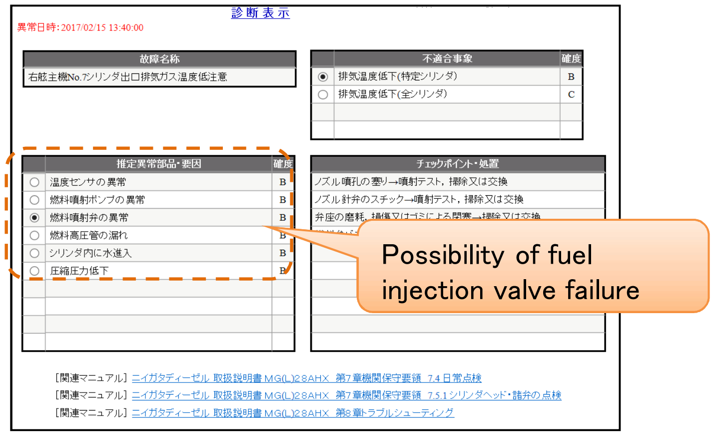
- Failure prediction function detected that the exhaust temperature began to decline 30–40 ℃ from the normal range.
- Since failure diagnosis function showed possibility of fuel injection valve failure, crew changed this valve to new one.
- In this example, this ship was able to avoid serious trouble caused of fuel injection valve in advance.



●Correlation graph



●Level trend graph

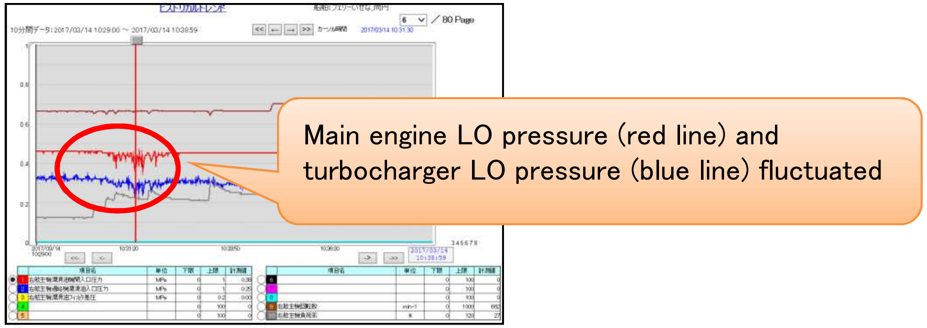


●Diagnosis result

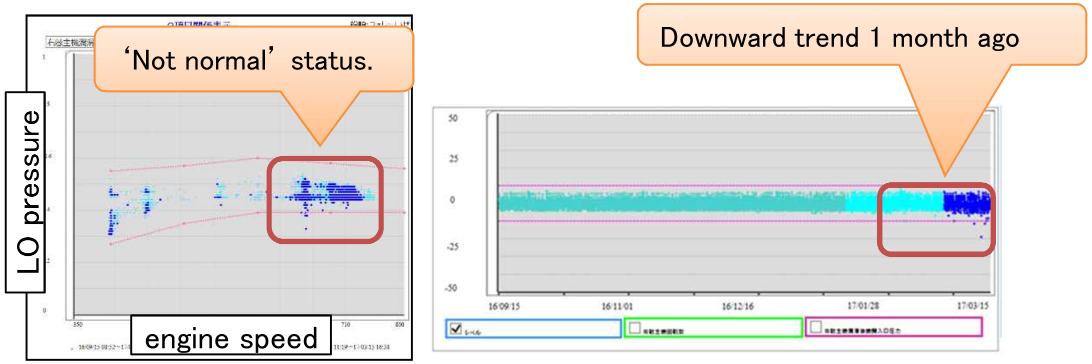
3. Remote monitoring system functions (Data analysis and diagnosis)

●Example "Main engine LO pressure lower"

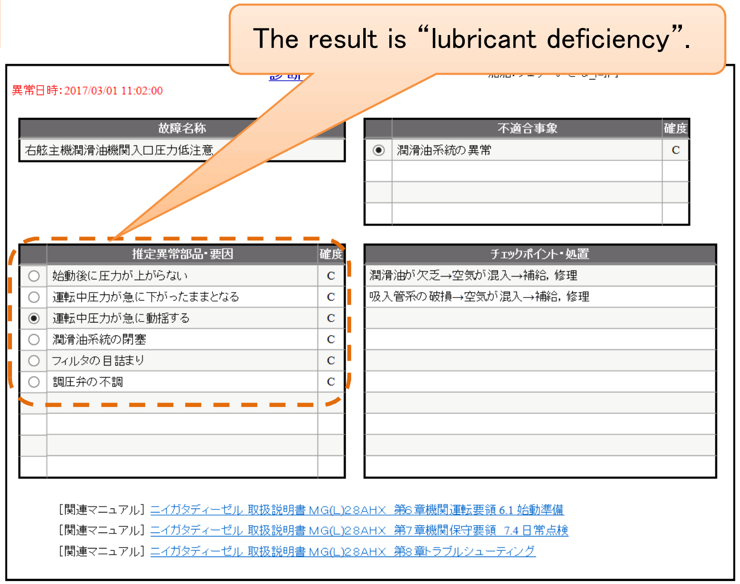
- In this phenomenon, main engine LO pressure fluctuated around for 1 minute after 10 minutes of clutch ON like following figure and monitoring system predicts the failure.
- Two parameters correlation showed 'not normal' status and 6 months also showed downward trend 1 month ago from this phenomenon.
- As for this failure prediction, crew checked LO line and found air entrainment of pump.



●Trend graph



●failure prediction result



●Diagnosis result

1. Motivation of Development

2. Introduction of NIIGATA Remote monitoring system

3. Remote monitoring system functions
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4. Summary

4. Summary

●Summary of presentation

- I explained the maritime industry and the motivation for developed an NIIGATA remote monitoring system.
- I introduced IPS engine, azimuth thruster, and the delivery record of the marine remote monitoring system along with the history of development.
- I explained the functions of the NIIGATA marine remote monitoring system. I focused on the failure prediction and failure diagnosis functions with specific examples.

●Current technical issues

- Mobile may not be introduced due to legal restrictions in some countries.
- In the failure prediction, the user needs to work on updating the threshold value.
- Failure prediction can calculate the degree to the normal range, but it does not provide time for replacement.
- The failure diagnosis function does not have a preventive function.

4. Summary

●Future tasks

Tasks to solve	Activities
Reduction of ship-land communication costs	Trail of using “ASM” technology for ship-land communication.
Furthermore accurate prediction and diagnosis	Application of AI technology like machine learning, deep learning, etc. This technology would assist accurate threshold.
Optimal maintenance Calculation of replacement time	Establishment of life time prediction method for optimal maintenance. This technology would contributes reduction of maintenance costs for ship owner and optimal parts supply for our support engineer.
Effective education and support system for crew	Not only trouble shooting, but also supports the daily check of crew like work procedure and check record. This function will bring advantages which burden on crew will be reduce and growth of crew’s skill will be enhanced.

thank you for your attention

