



# **Eco-friendly Pump Dredger Renovations**

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- ▶ Remodeling barge loading system ~ CHIYODA
- ▶ Remodeling tube transport system ~ TSUKUBA
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# INTRODUCTION · · · Background

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- ▶ Pump dredger has been active for many years.
- ▶ However, some environmental problems.

Turbid water

Exhaust gas



Renovations to existing old pump dredger, Eco-friendly dredger.

# MODIFYING EXISTING PUMP DREDGERS INTO ECO-FRIENDLY PUMP DREDGERS

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The CHIYODA ,



Barge loading system

The TSUKUBA ,



Tube transport system

**More than 40 years old !**

# CHIYODA

## ▶ The barge loading method

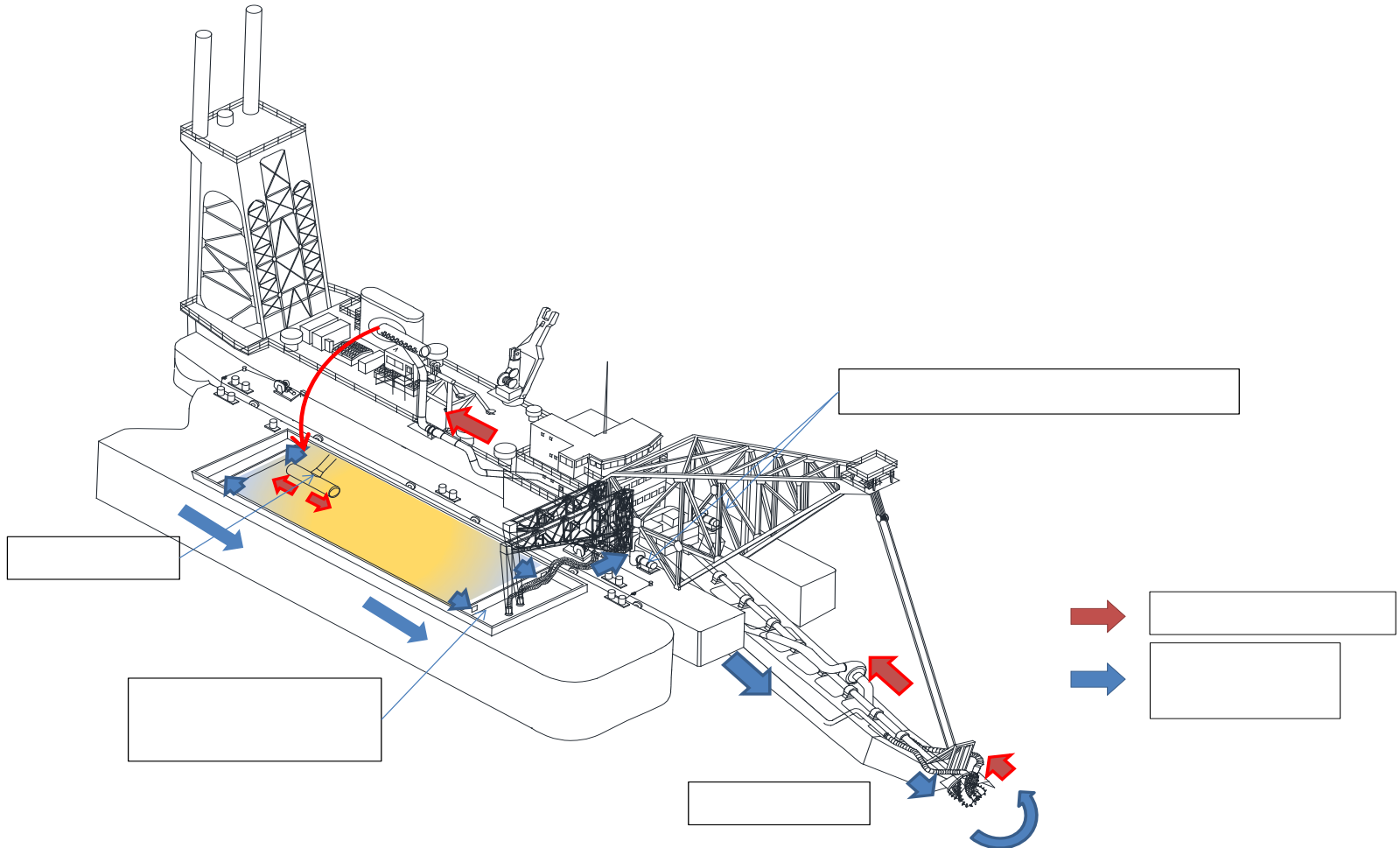
- ▶ Barge loading system is a way to be loaded into barges at the pump dredger.

Turbid water problem

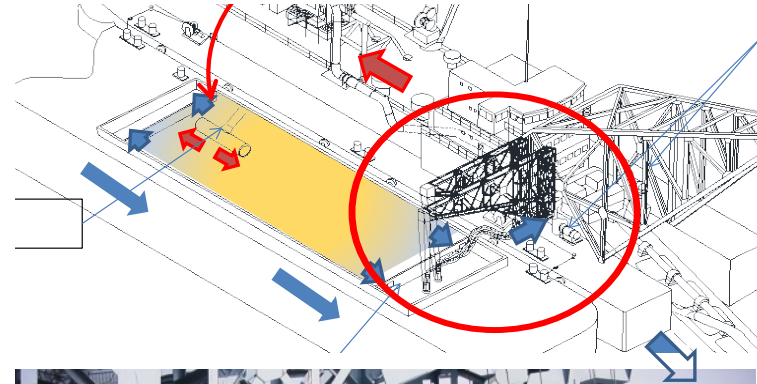


# CHIYODA

## ▶ *Reflux pump barge loading system*

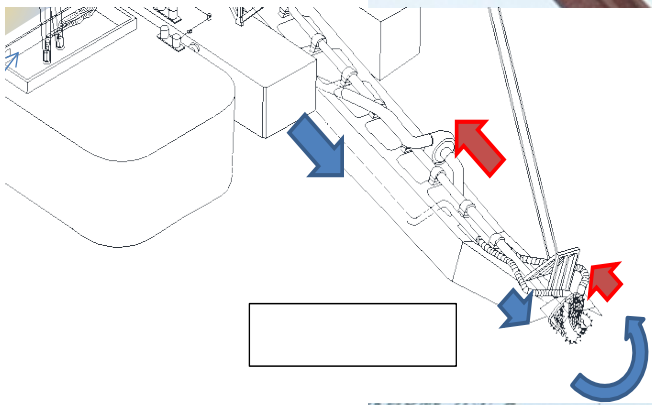


# CHIYODA (Reflux pump)



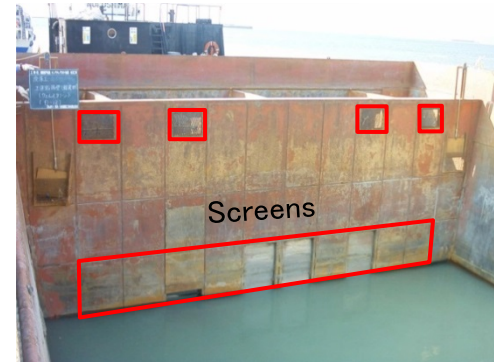
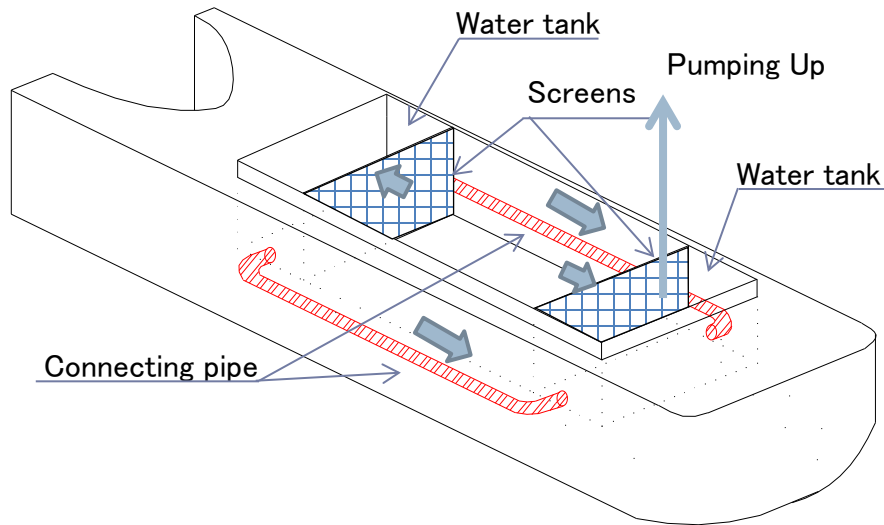
- ▶ Inverter control low head position type centrifugal pump
- ▶ The reflux pump suction rubber hose

# CHIYODA (Turbidity prevention cover)





# CHIYODA (Modification of the barge)



- ▶ Installing a water tank to store the overflow water
- ▶ Water tank is connected by a water pipe, the structure can be sucked from one side of the water tank.

# CHIYODA (Dredging operation)



## 【Construction process】

Positioned by GNSS.



The barge is positioned alongside.



The ladder pump is activated.



Reflux pump set  
Start-up



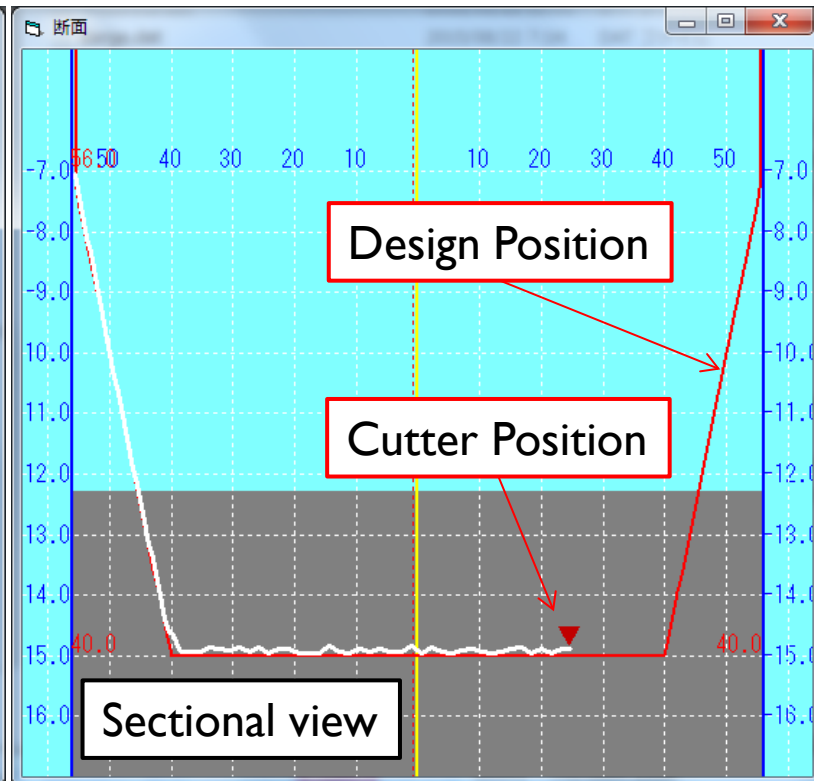
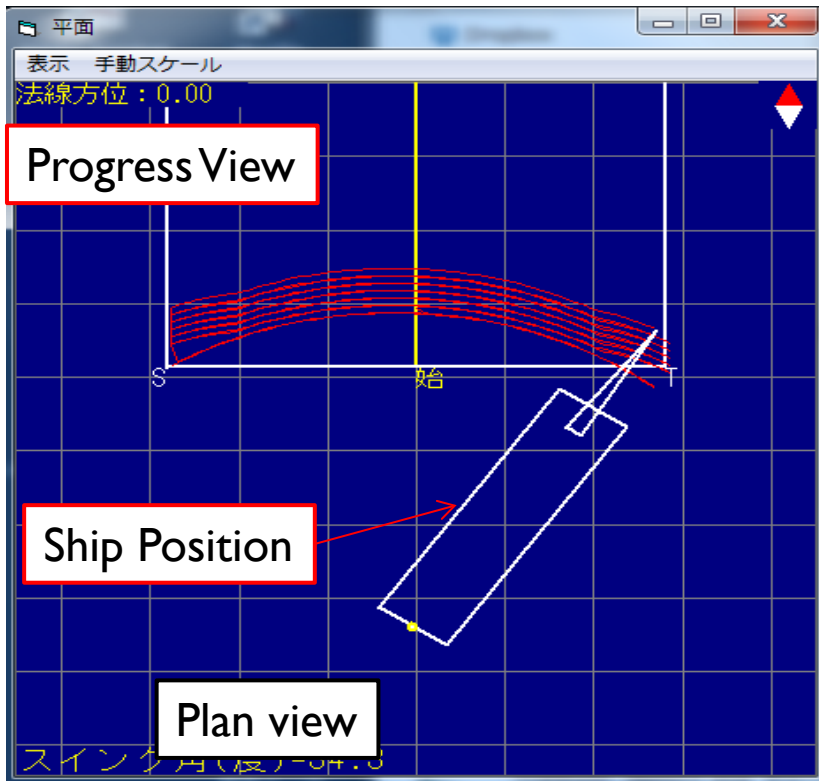
Start dredging



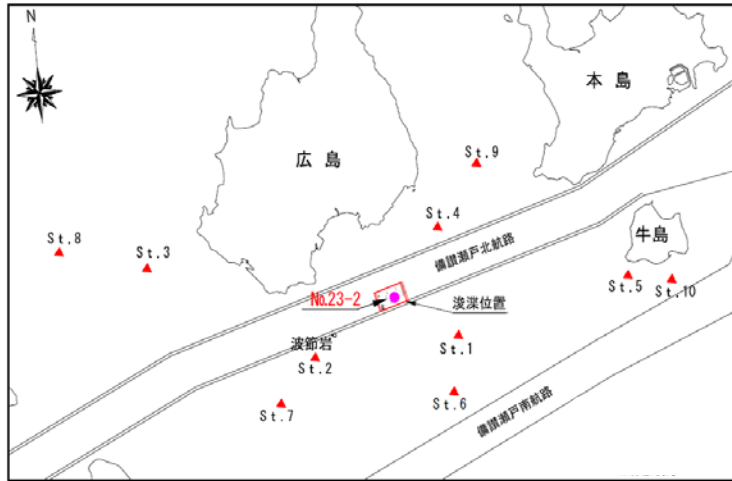
Dredging the end

# Dredging Management System

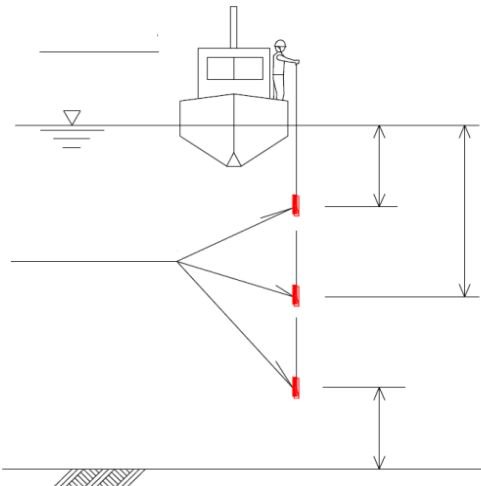
Ship Information		カッター位置		スパッドNo. 9		前進距離(m) 2.0		戻り		
X(m)	-65.87	28.46	カッター位置	残離距離(m)	571.5	船位計				
Y(m)	0.00	-2.50	カッター位置から	障害物(m)		スパッド番号変更				
方位(度)	-1.52	カッタースピート(m/min)	19.6							
GPS Mode	Pdop	Svn	距離(m)	カッター深度(m)	潮位(m)	スパッド打替				
未	3 3	1.21.2	8 8	-2.5	-15.1	0.00	入力			



# CHIYODA (Effect of turbidity suppression)



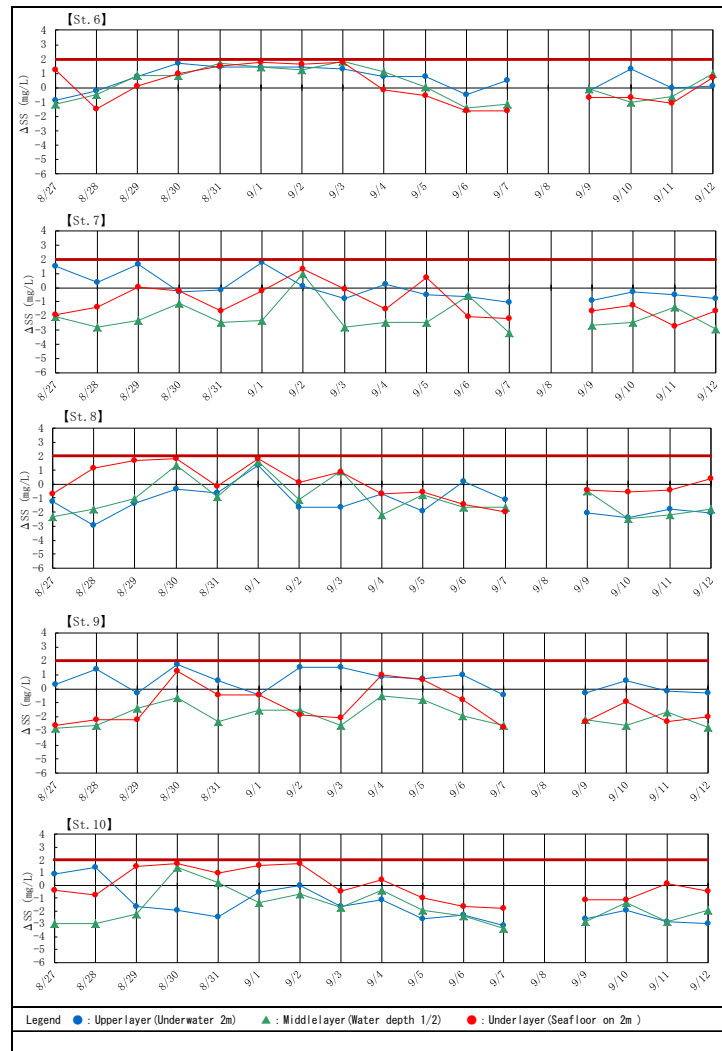
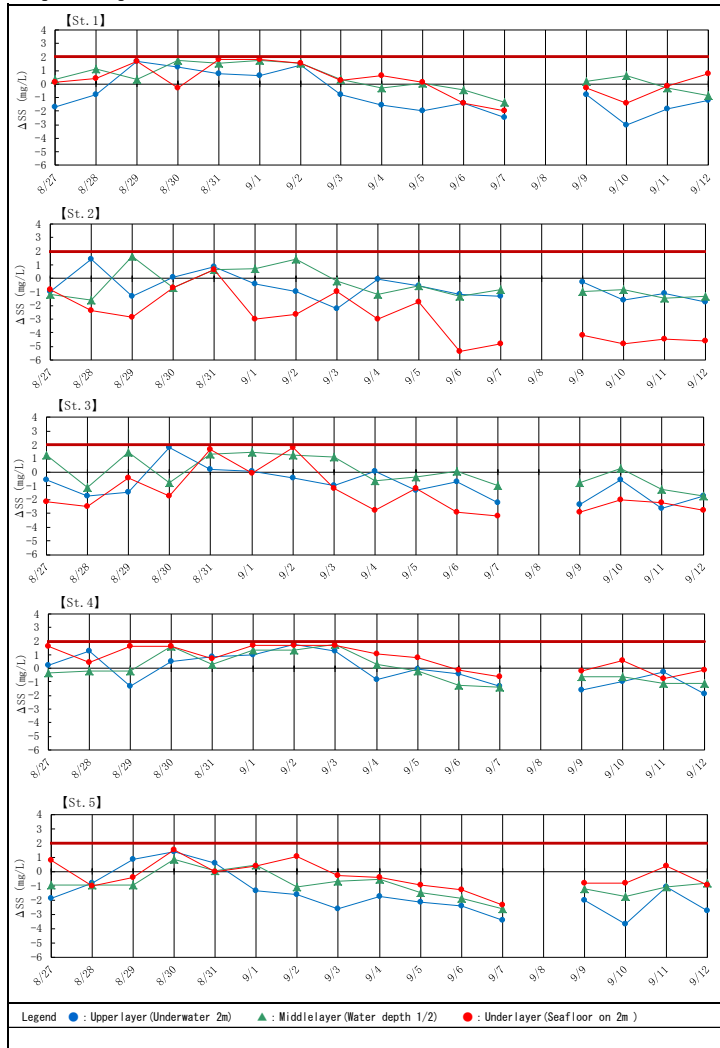
	Bearing and distance from the base point			
	Bearing	Distance	Bearing	Distance
St. 1	89° 54' 40"	2397m	34° 20' 42"	133° 44' 21"
St. 2	222° 37' 58"	531m	34° 20' 29"	133° 42' 33"
St. 3	288° 02' 19"	3784m	34° 21' 20"	133° 40' 26"
St. 4	46° 26' 18"	2754m	34° 21' 43"	133° 44' 05"
St. 5	79° 25' 58"	5758m	34° 21' 16"	133° 46' 29"
St. 6	113° 06' 43"	2514m	34° 20' 10"	133° 44' 17"
St. 7	220° 17' 16"	1570m	34° 20' 03"	133° 42' 07"
St. 8	285° 19' 26"	5487m	34° 21' 29"	133° 39' 20"
St. 9	42° 17' 30"	4077m	34° 22' 20"	133° 44' 35"
St. 10	81° 23' 58"	6578m	34° 21' 13"	133° 47' 02"
No. 23-2	61° 69' 28"	1252m	34° 21' 02"	133° 43' 30"



# CHIYODA

## (Effect of turbidity suppression)

Management target value ( $\Delta\text{SS} \leq +2.0$ )



# TSUKUBA

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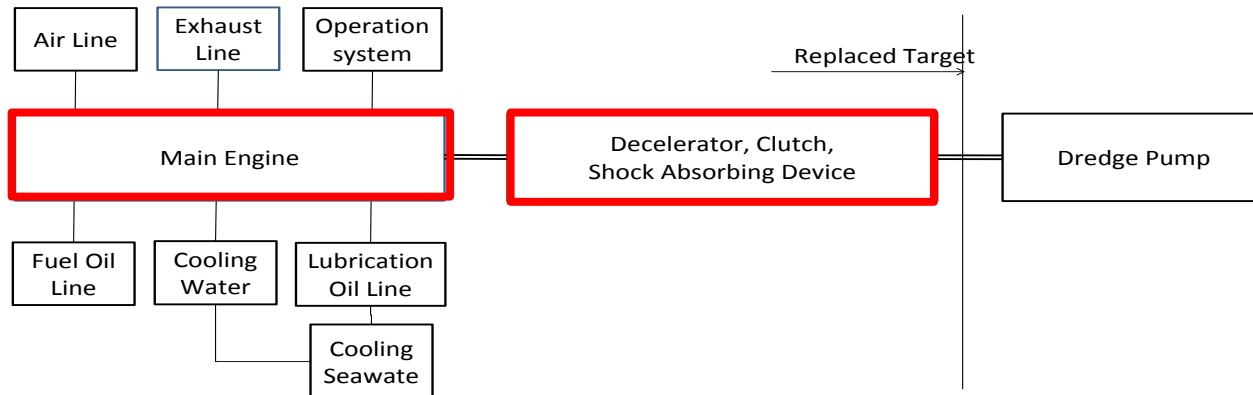
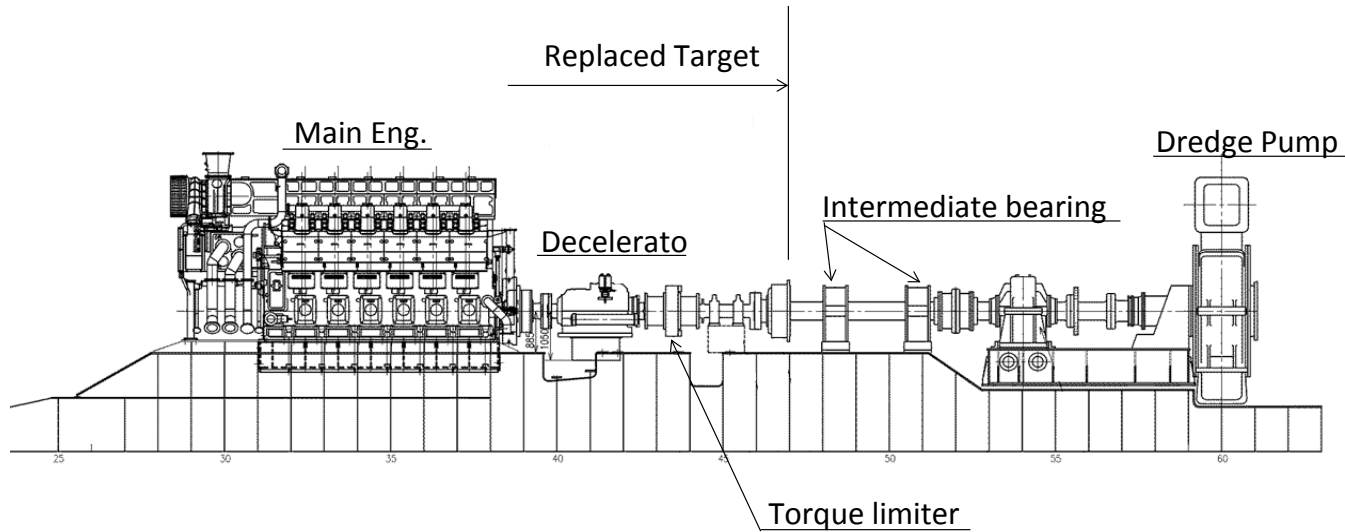
40 years from construction have passed

Old Movers  
Fuel consumption, exhaust gas, very bad

Remodeling of the prime mover

Environment-friendly pump dredge

# TSUKUBA (prime mover configuration )



# TSUKUBA

(The problem with the main engine replacement)

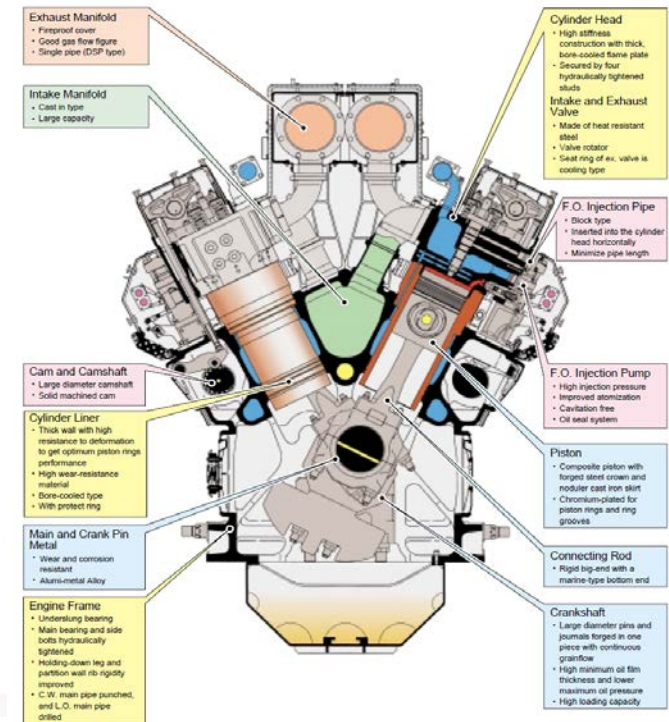
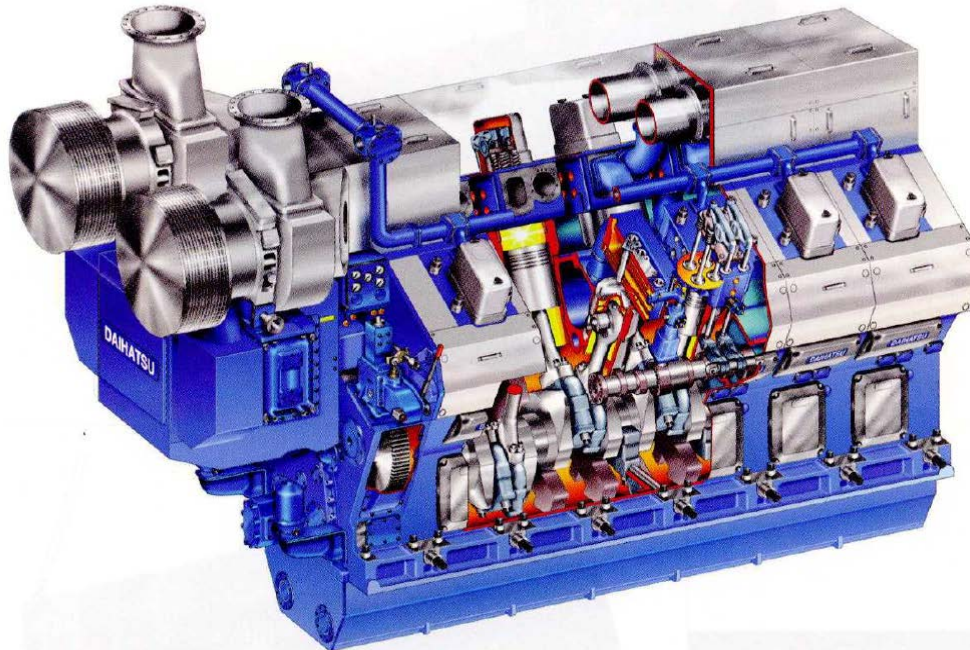
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- ▶ Hull strength
- ▶ Engine space
- ▶ Matching with existing equipment
- ▶ Exertion of performance



# TSUKUBA (Features of the main machine)

- ▶ Main machine I2DK-36e (DAIHATSU)
  - ▶ I2-cylinder V-type
  - ▶ Medium-speed diesel engine in which it is excellent in durability



# TSUKUBA (Comparison of old and new engine)

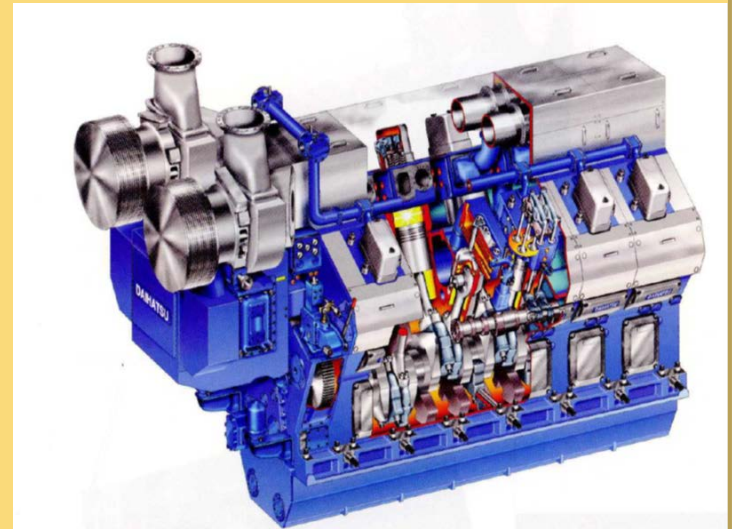
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			OLD	NEW
1	Main Eng.	Model name	<b>HITACHI</b> B & W 12U45HU	<b>DAIHATSU</b> 12DK-36e
2		Rated output	5,340kW * 465rpm	5,340kW * 560rpm
3		Fuel	Fuel oil A	Fuel oil A
4		Fuel consumption rate	222g/kW-h	188g/kW-h
5		Governor	Mechanical	Electronical
6		Supercharger	○	○

# TSUKUBA (Features of the main engine)

- ▶ Eco-friendly main engine
  - ▶ Energy savings
    - ▶ Reducing fuel consumption provides economic benefits and helps reduce CO<sub>2</sub> emissions and environmental impact.

- ▶ Electronically controlled governor
- ▶ Improved fuel injection pump
- ▶ Improved fuel injection valves
- ▶ Turbocharger



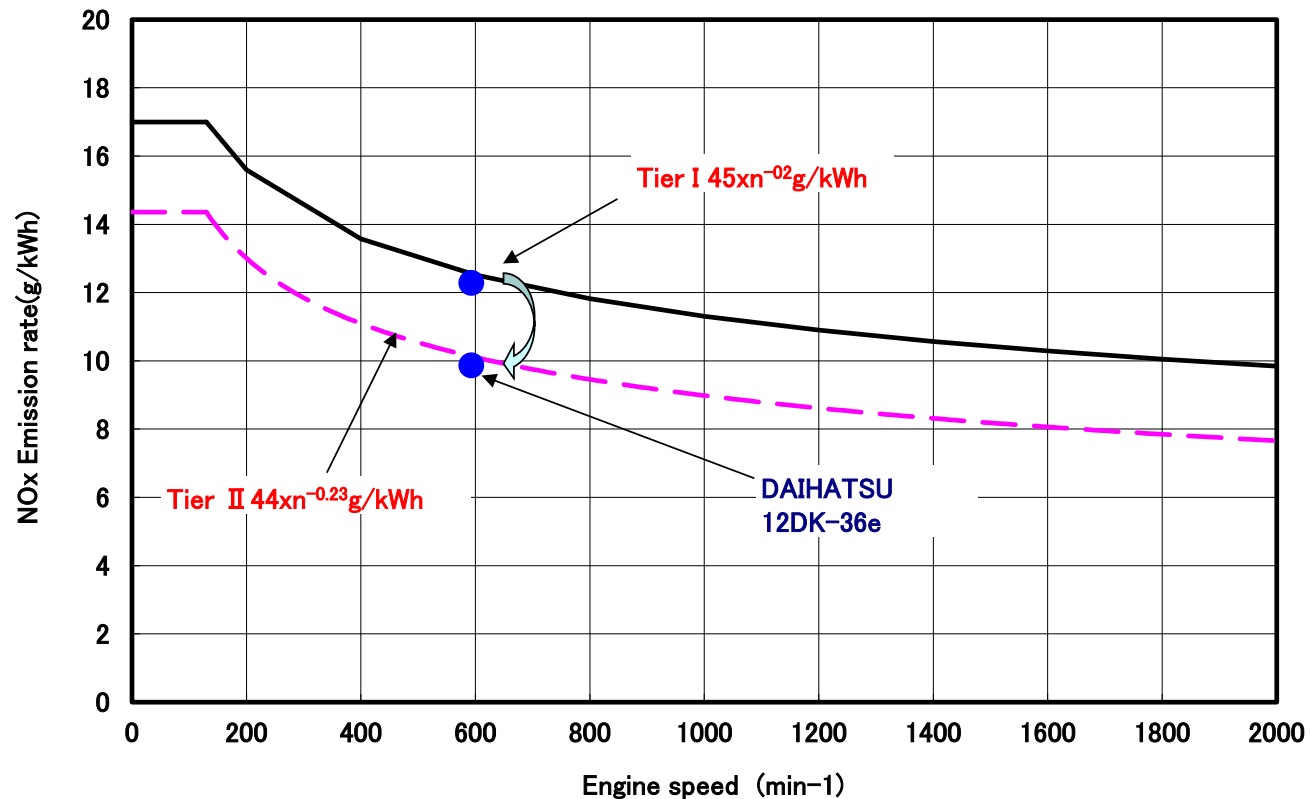
# TSUKUBA (Effect)

	Unit	Before remodeling	After remodeling
Energy consumption	kL	406.00	381.70
Production volume	m <sup>3</sup>	227.45	227.45
Specific energy consumption	kL/m <sup>3</sup>	0.0018	0.0017
Energy-saving rate	%	6.0	
Energy-saving amount	kL/Year	24.3	

- ▶ Energy saving rate of 6.0%
- ▶ Energy saving amount 24.3KL / year

# TSUKUBA (Features of the main machine)

- ▶ Eco-friendly main engine
  - ▶ Compliance with IMO NOx (Tier II)



# TSUKUBA

(Removal situation)

Removal situation



Recycling parts



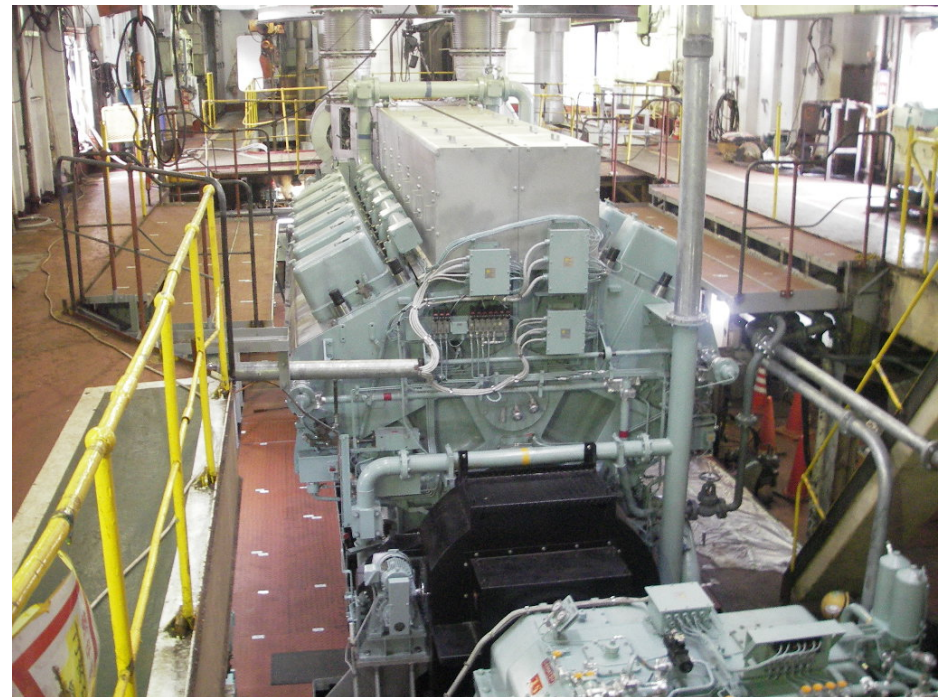
# TSUKUBA (Installation situation)

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Mounting situation



Completion of installation



# TSUKUBA (Test-drive situation)

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Engine monitoring



Test-drive situation





# TSUKUBA (Construction situation)

Construction  
situation



Discharge  
situation

# Conclusion

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- ▶ Pump dredging construction, turbidity and of dredging, emissions of CO<sub>2</sub> and NO<sub>x</sub> is a problem due to the large amount of fuel consumption.
- ▶ It is difficult to build a new dredger in Japan.

- Equipped with the new technology to the old dredger.
- It is very difficult.

- ▶ Necessary to the dredging work of environment-friendly in Japan.

**Thank you for your kind  
attention**

Did I speak well?

