# IMR fleet - update

Johnny Ytreland

Fleetmanager

Research Vessel Department - Institute of Marine Research

ERVO 2017, Helsinki 13-14 June

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

# Presentation

- Kronprins Haakon – short update
- Dr. Fridtjof Nansen – update and «singing propeller»
- Kristine Bonnevie – Conversion-some experiences
- Johan Hjort – New propulsion – hybrid experience

# Kronprins Haakon


Delivery ultimo 2017

# Technical details

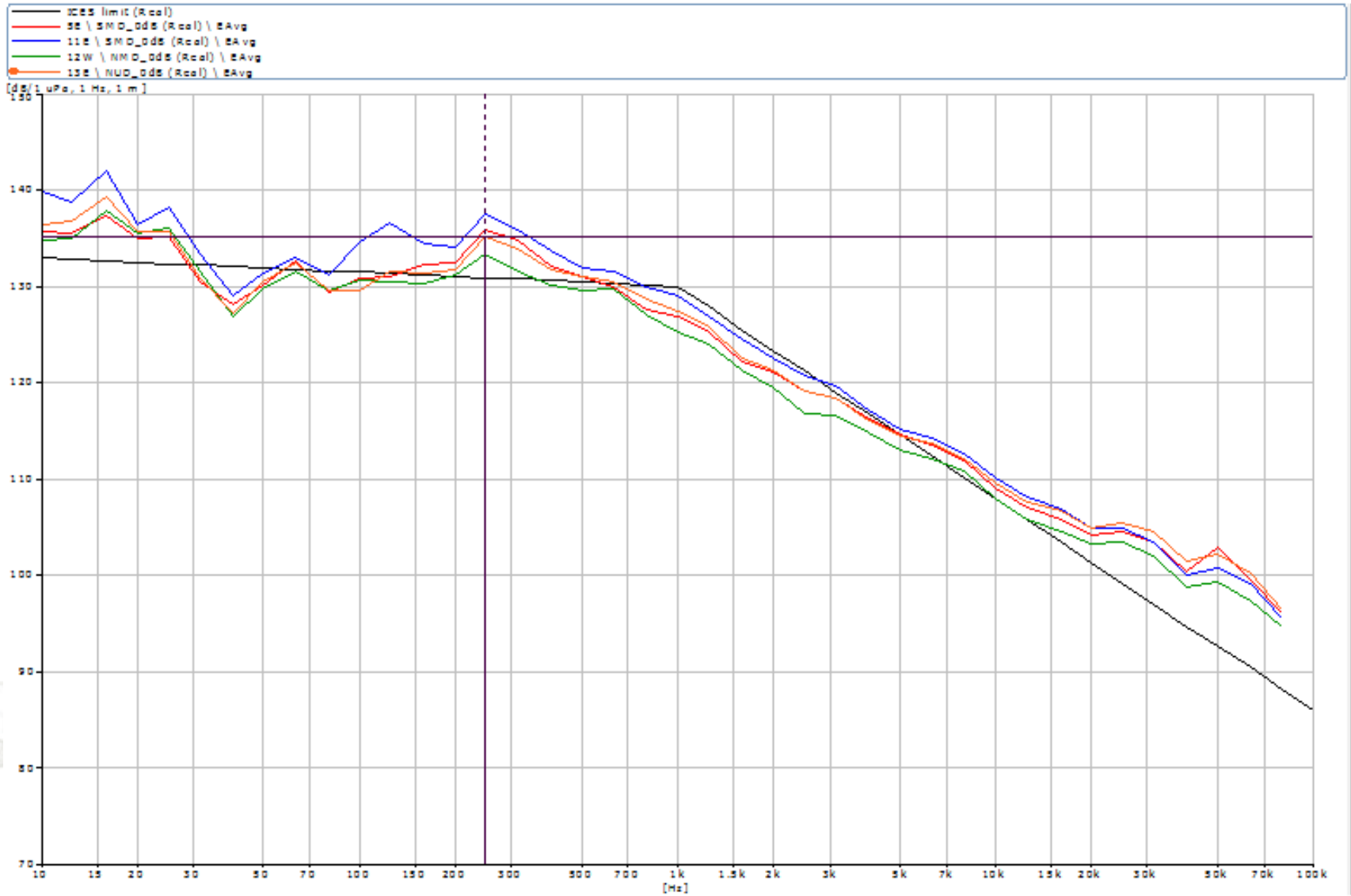
- Length over all (LOA): 100,0m
- Breadth: 21,0m
- Draft: 8,5m
- Gross tonnage 10900T
- IMO Polar Class PC-3 *Year-round operation in second-year ice which may include multi-year ice inclusions.*

CLASS:
DNV + 1A1, E0, RP, NAUT–OSV(A), CLEAN DESIGN, PC3 Icebreaker, DAT(–35), WINTERIZED BASIC, HELDK–SHF, DYNPOS–AUTS, COMF–V(3)/C(2), DK(+)

# Dr. Fridtjof Nansen

- Delivered 4th January 2017.
- Test periode in Bergen waters until 29th April.
- Arrived Casablanca in Marokko 6th May for mobilisation and started operations the 8th.

# DFN – Singing propeller
# First test - January



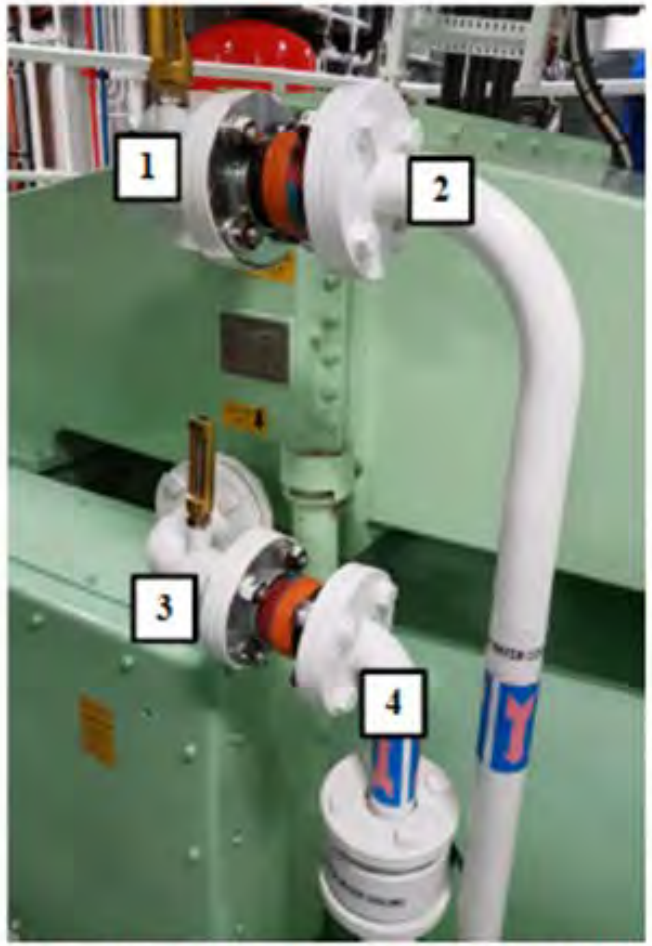
# Structure borne noise measurements

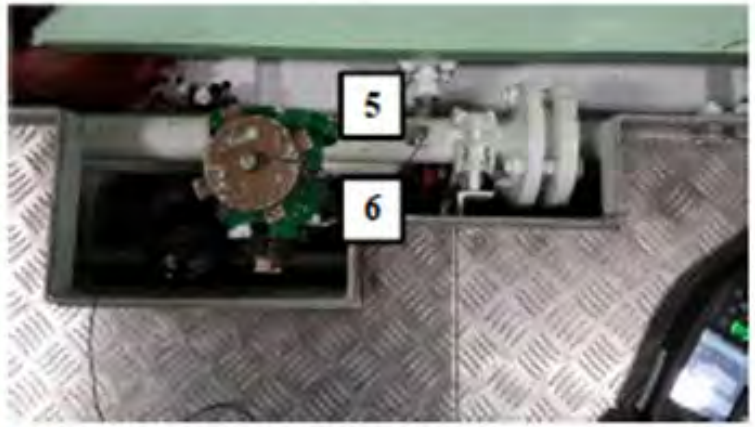
## on board the research vessel Dr. Fridjof Nansen

**At this point I see a big chance to improve the situation for the emitted noise into the water!**

Further on we checked the flexible pipe connections and felt high vibrations at the cooling water piping of the generator cooler even after the rubber compensator. As the distance between the compensator and the first fix point of the cooling water outlet pipe is very long the vibrations seemed to be very high also at the rest of the piping along the genset foundation.

Generator cooling pipes




measurement positions at generator cooling pipes

# Propeller

## 2. Original propeller design

The original propeller design was done by ——— based on the experience on other ICES research vessels built in Spain. Preliminary propeller design was done using PPB panel code from HSVA and final optimization was done running the propeller behind the final hull on ——— Code STAR CCM+. Propeller design was described on report ———

## 3. Tank testing at Marintek

The propeller ——— was tested at Marintek for free run (14.2 knots), silent (11 knots) and towing conditions. The test didn't show any potential problem to be expected at full scale.

More information can be found at Marintek report

## 4. Manufacturing

Manufacturing of the propeller was carried out in ——————————— according to ISO 484/I tolerances and inspection was done by DNV according to applicable rules.

# Change of propeller

## 6. New design requirements

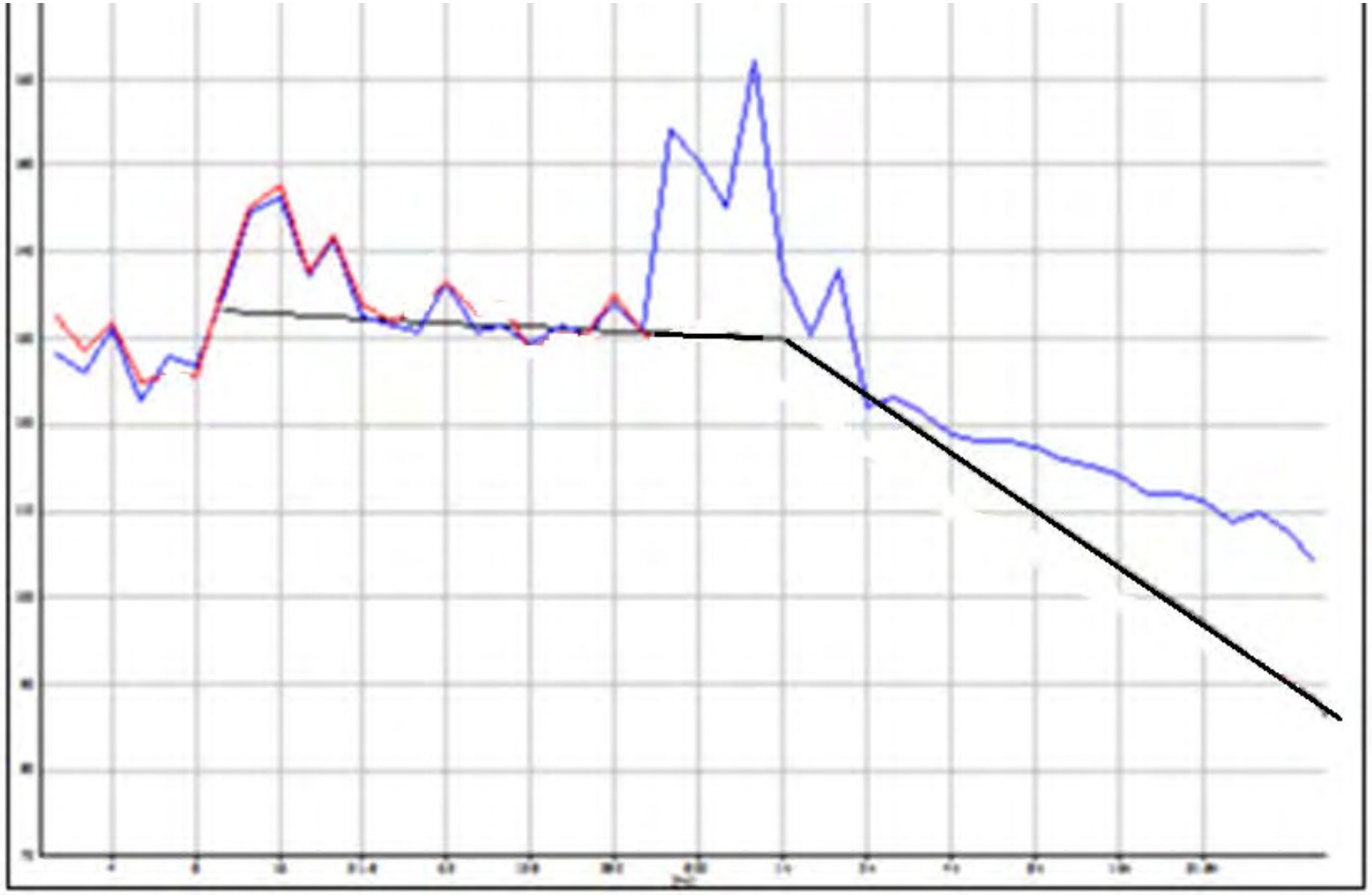
The requirements for the new design of the propeller are:

- Remove any cavitation from the silent speed of 11 knots.
- Eliminate singing phenomena.

This should be achieved while keeping speed, power and diameter of the current propeller. Furthermore, propeller weight and inertia should be as close as possible compared to the original design to keep shaft alignment, whirling and torsional characteristics of the system.

New propeller was installed 14-17th April

# Noise test new propeller – 18th April



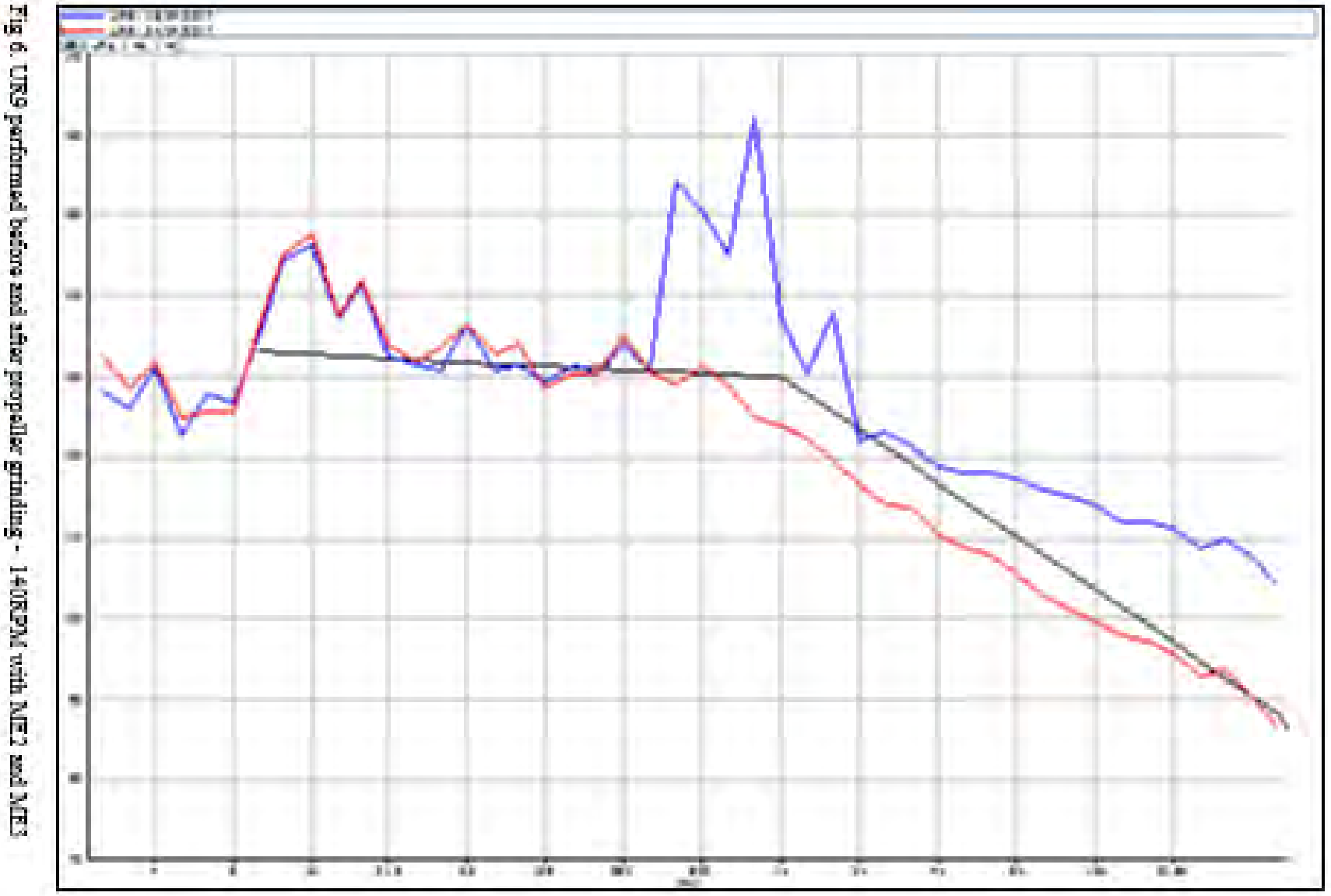
# Video
# Inspection of the propeller after grinding

# Noise test after grinding the propeller 24th April

11 knots

Blue is the test after change of propeller.

Red is the test after grinding the propeller for anti-singing.



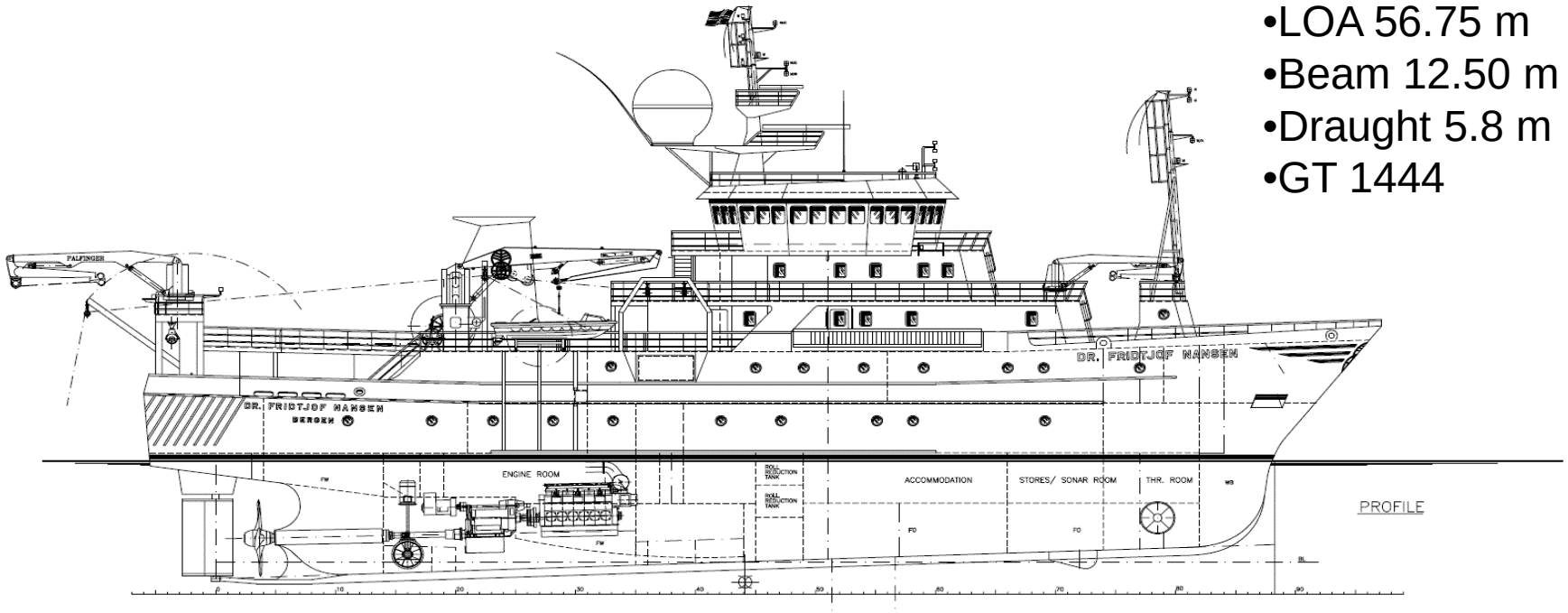
# Conversion
# «Old»Dr. Fridtjof Nansen – Kristine Bonnevie



Built in 1993
Operated in Africa most of the time

Converted in 2016-17
Will operate in Norwegian waters

# Scope of work  ”Kristine Bonnevie” (1)



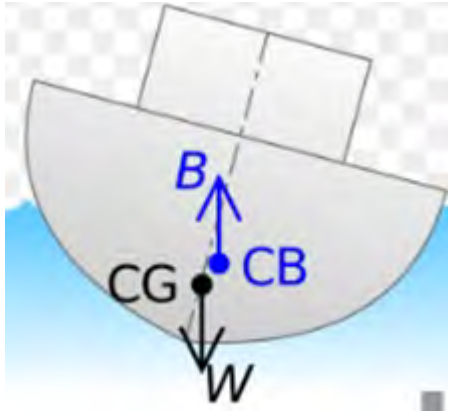

- LOA 56.75 m
- Beam 12.50 m
- Draught 5.8 m
- GT 1444

- New tunnel thruster aft.
- A DP light system to be installed.
- New A-frame aft.
- One new winch for a towing wire and one new winch for coax wire
- New crane aft
- New fish-lab on shelter deck.
- General maintenance

# Challenges

- Deadweight
  - Inclining experiment in 2011 show that the vessel is heavier than expected.

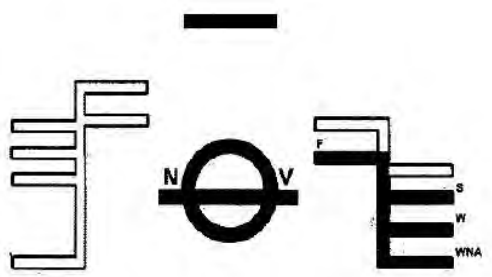
- Stability
  - Inclining experiment in 2011 show limited stability.
  - For operations in the Arctic, icing on deck add stability requirements
  - Fixed ballast will add deadweight.



# Loss of fuel capacity moving from summer to Winter North Atlantic and add Ice conditions

| Freeboard from deck line: | | |
|---|---|---|
| Tropical | - | mm (T) |
| Summer | 2455 | mm (S) |
| Winter | 2566 | mm (W) |
| Winter North Atlantic | 2616 | mm (WNA) |
| Timber tropical | - | mm (LT) |

From S to WNA is 17cm
TPcm = 5,35
Gives a fuel reduction of 5,35x17=
91tons compared to the operations on West Africa



# Plan

- Reduce the deadweight as much as possible.
  - Remove everything that is not needed onboard.
  - All spareparts that is not critical for daily operation will be taken ashore and stored in Bergen.
  - Grit blast to remove some layers of old paint.
- Blank off some of the fuel tanks to reduce fuel requirements in the ”arrival condition”.
- Add approx. 80 tons of fixed ballast.

# Conclusion

- Removal of old spares and various equipment stored helped a lot.
- Incinerator and a «fish vacume pump system» were removed ++
- Hydro blasting of the whole hull and superstructure gave good effect.
- We install only 55 tons of fixed ballast.

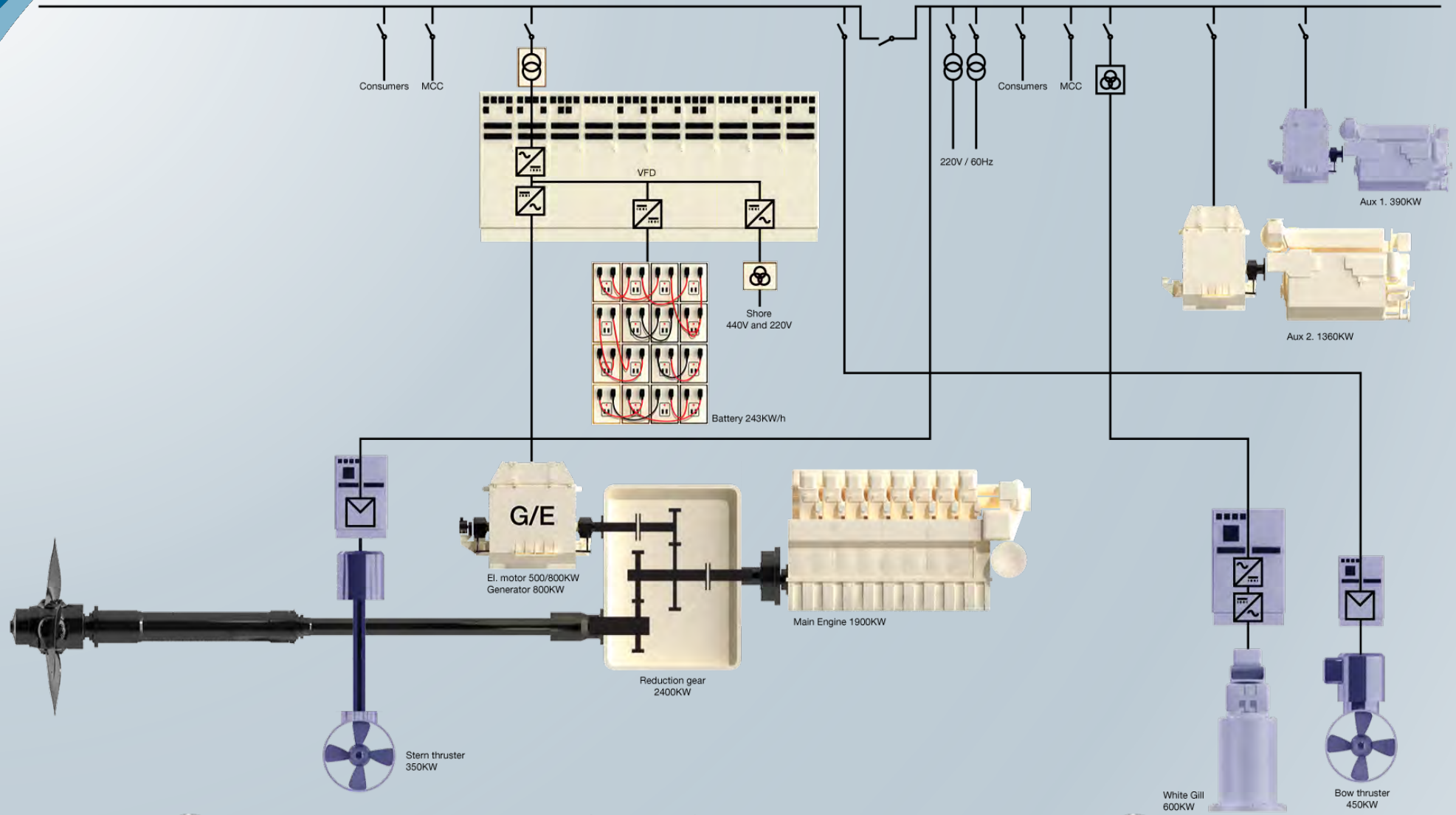
- Today the stability is good and she has endurace enough (40-45 days) for the operations in Norwegian waters. A litle less during winter operations.

# Johan Hjort – New propulsion and bridge

# Upgrade targets for the propulsion

- Increase operational safety.
- Reduce fuel consumption.
- Reduce emissions.
- More flexible shore power capabilities.
- Reduced on-board noise.
- Reduced underwater radiated noise.

# System overview: propulsion & power distribution.

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HALVORSEN

pon CAT

Scana PROPULSION

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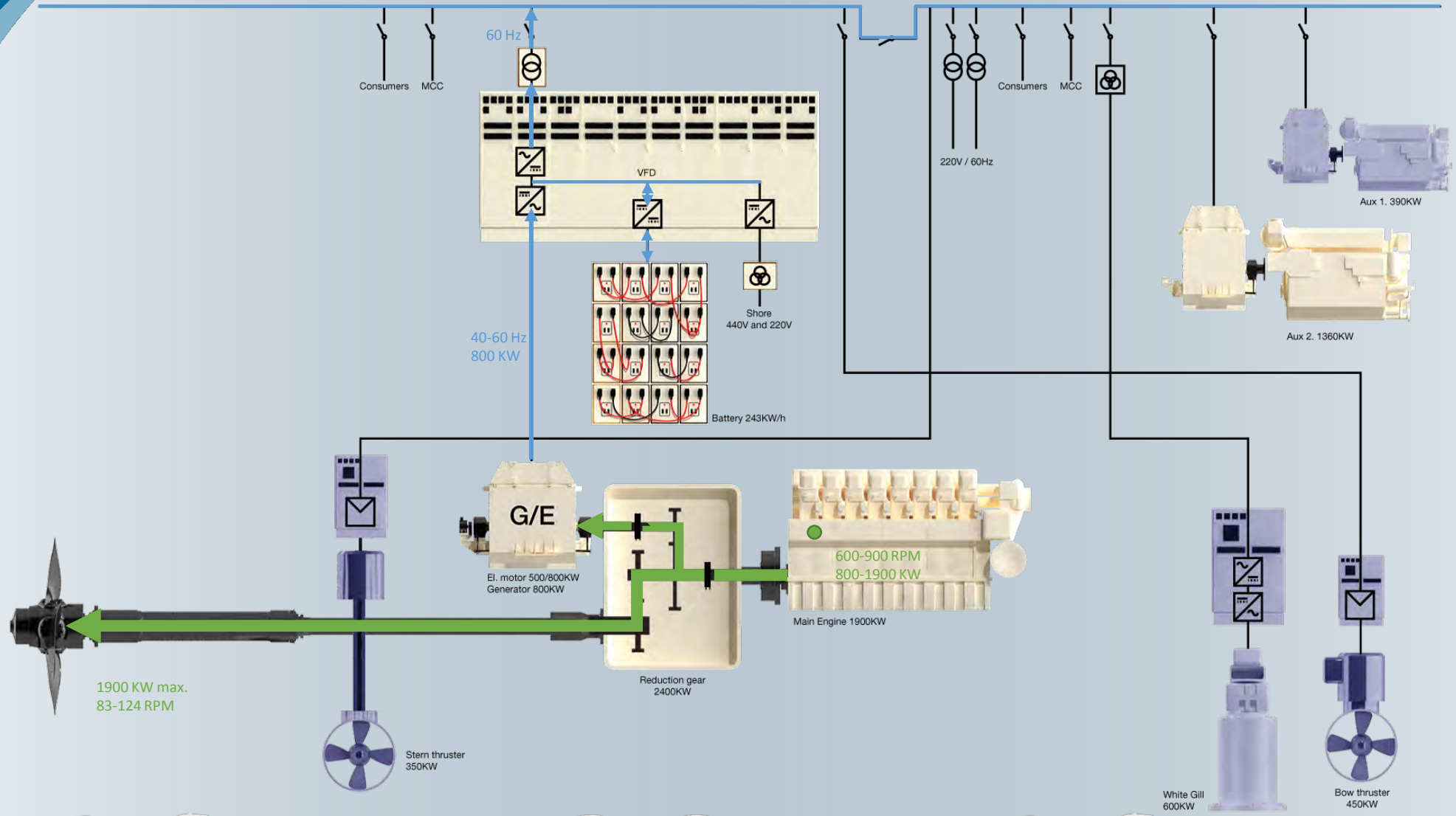
# Propulsion: Diesel mechanical mode W/PTO available.

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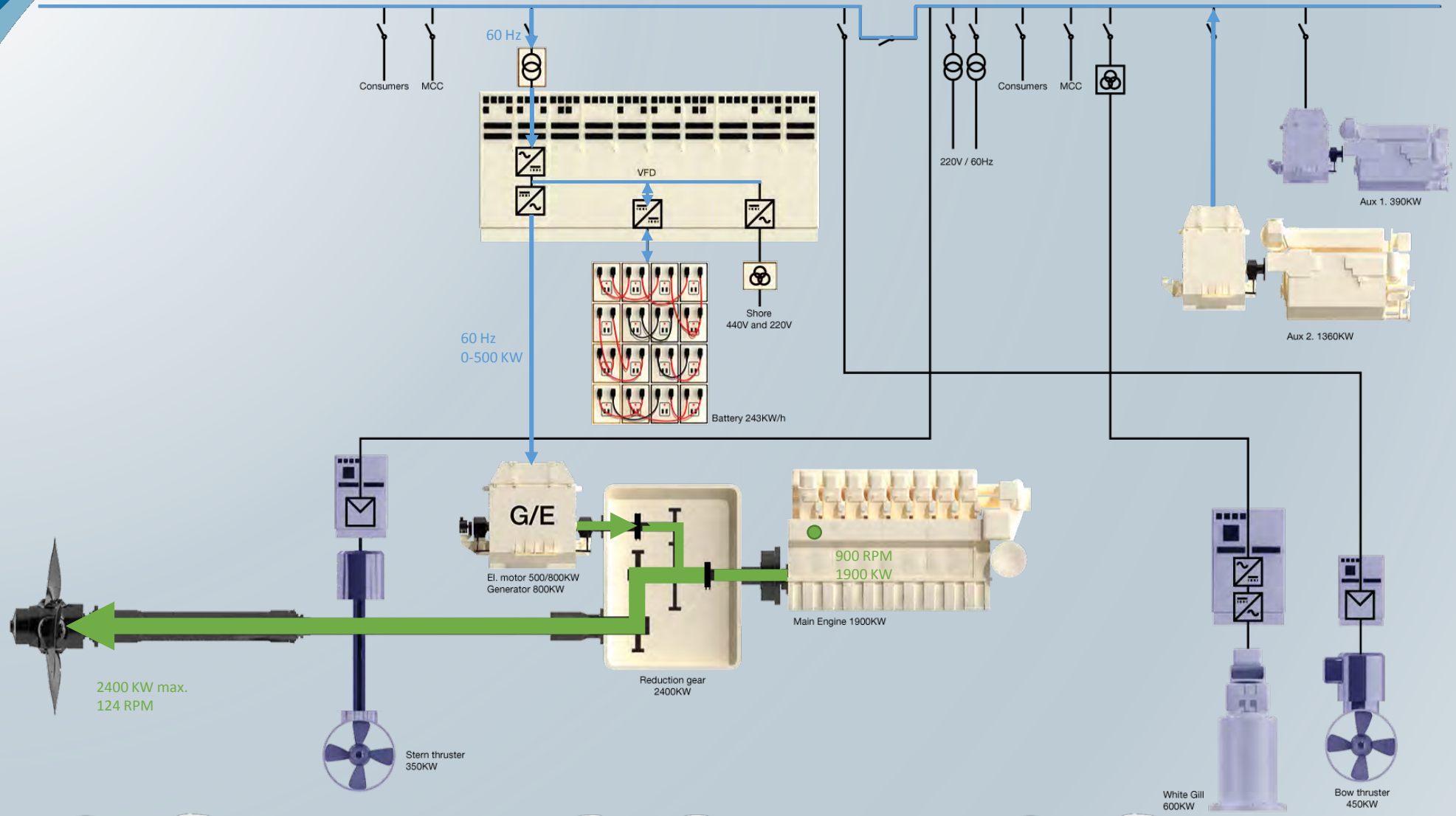
# Propulsion: Diesel mechanical mode W/Boost.

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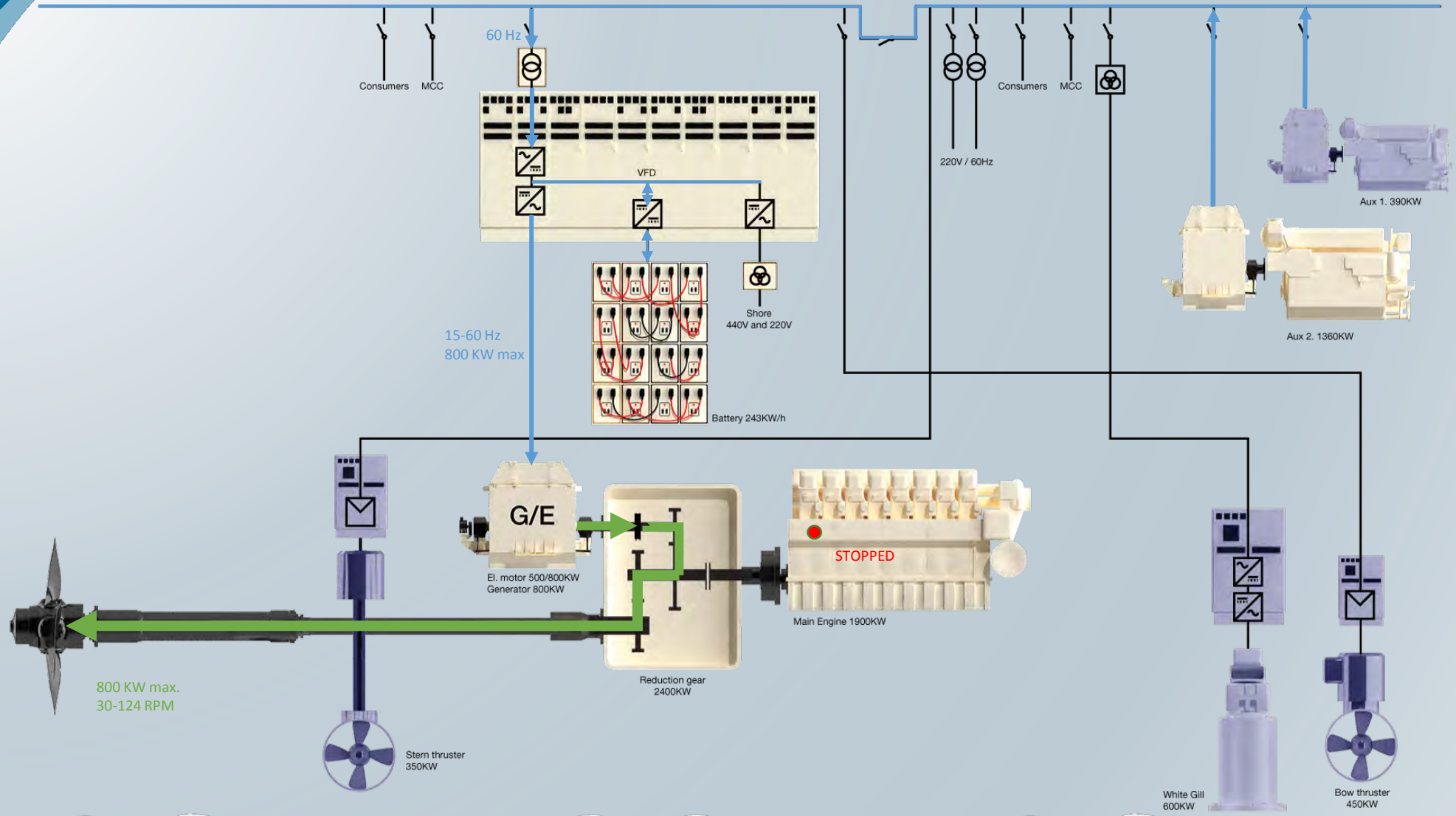
# Propulsion: Diesel electric mode.




- Possible with one or two Aux. Running.

<u>Only new Cat 3512 running.</u>

- Silent mode. Double isolated mounting and >35dB exhaust noise reduction.
- IMO Tier III compliant. SCR and Urea plant.

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# Experience after 2 months of operations

- Delivery from yard delayed approx. 1 month. The electrical systems were more complicated than estimated.
- Maker struggle with load control in PTI mode with load shading from batteries. We are today not able to operation in this mode due to risk for black-out.
- Design speed in PTI mode (diesel electric) was 11 knots, but until now we only obtain ca. 10 knots.
- The vessel is operation well in Diesel mechanical mode.

# Questions ?