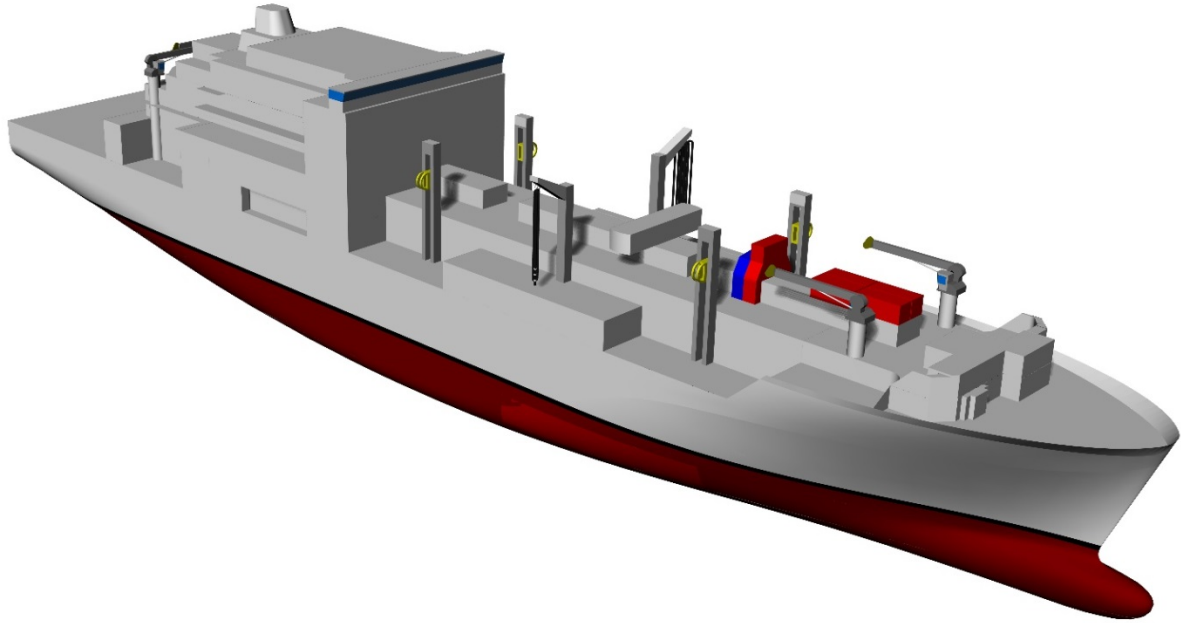
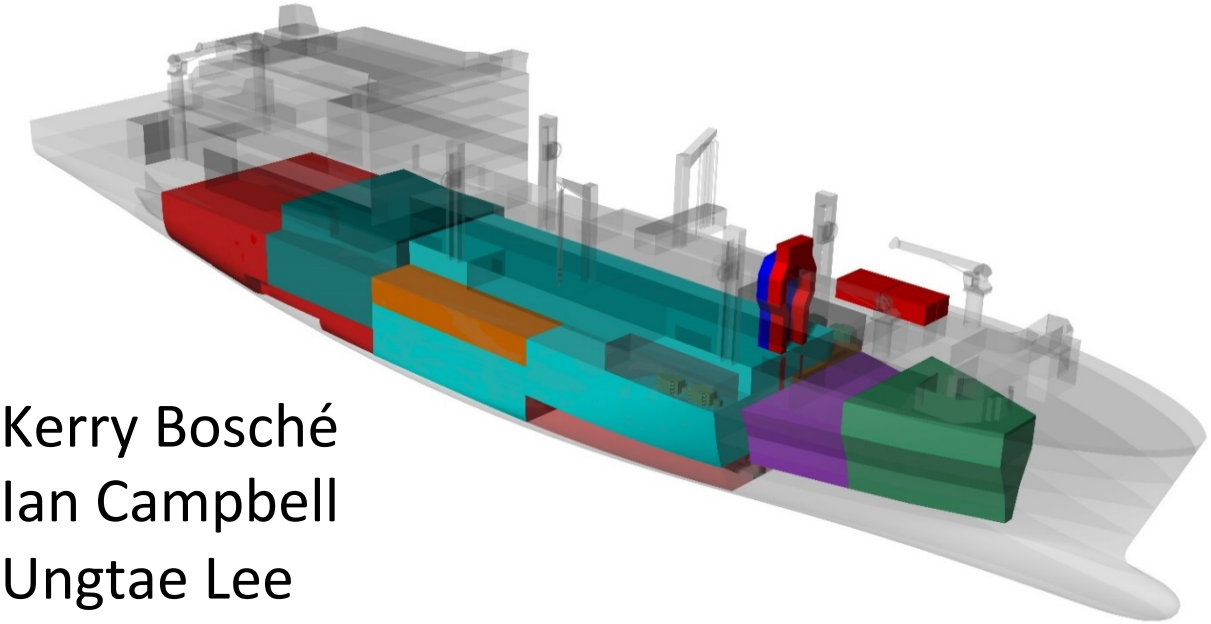
T-AKE (HA/DR)

(Humanitarian Assistance/Disaster Relief)

Naval Construction and Engineering
Ship Design and Technology Symposium
30 Apr 2014





LT Kerry Bosché
LT Ian Campbell
LT Ungtae Lee
LT Vanea Pharr

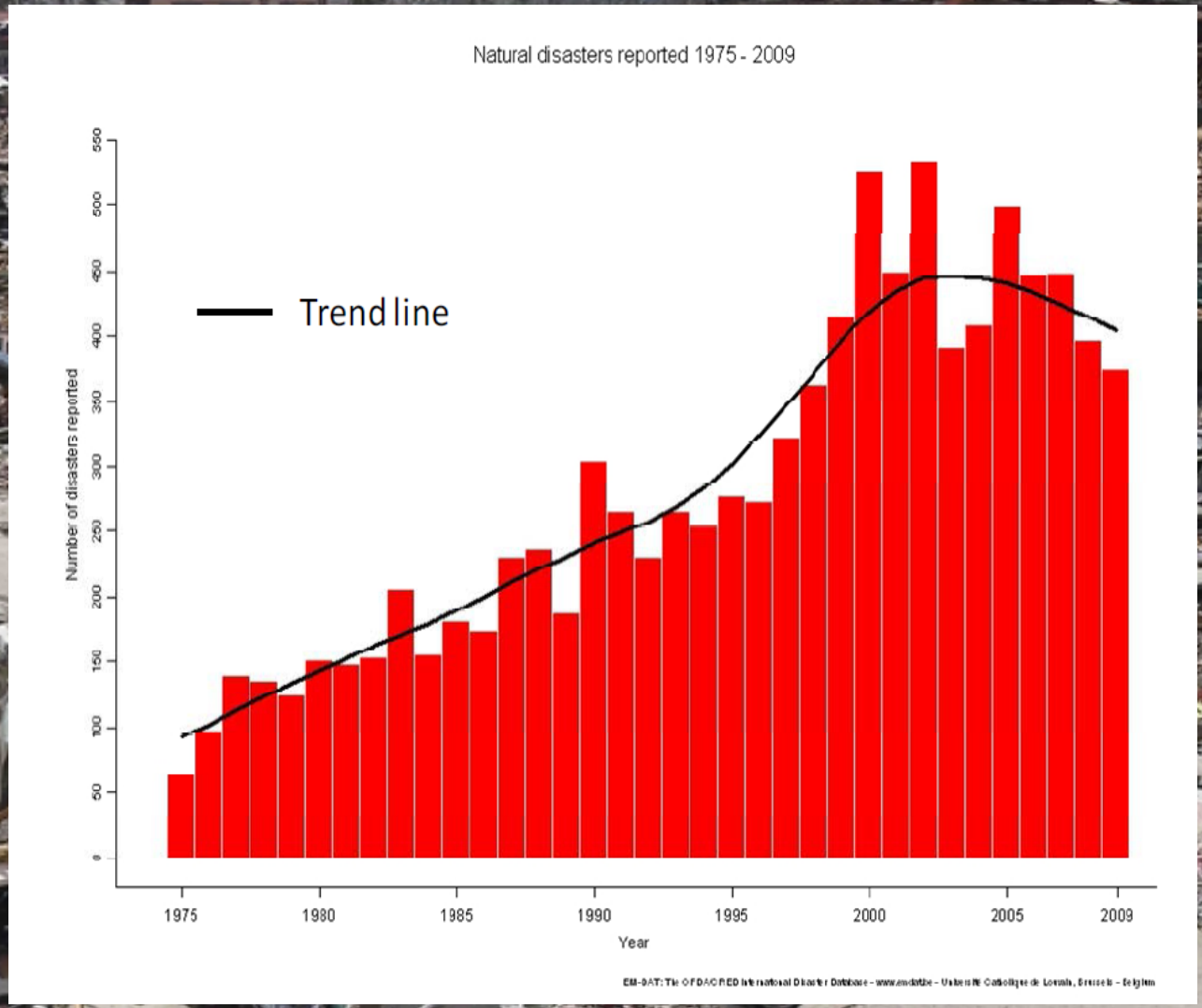
Introduction – Motivation & Objectives

Motivation

- Recent shift in the missions toward humanitarian assistance/disaster relief (HA/DR) missions.
- While capable, USN assets rarely align well with local needs.

Objective

- Design a conversion to the *Lewis & Clark* class T-AKE to better support the HA/DR mission.



Design Study – Design Philosophy

Add capability to the T-AKE class to provide for critical needs to an isolated population following a natural disaster.

In particular, address:

- Electrical power generation and distribution
- Potable water generation and distribution
- Medical support

Maintain UNREP capability above threshold values.

Balance UNREP capacity with HA/DR capability.

- Maximize the Overall Measure of Effectiveness (OMOE).

Design Study – Information Resources

Design Drawings (NAVSEA/ NASSCO)

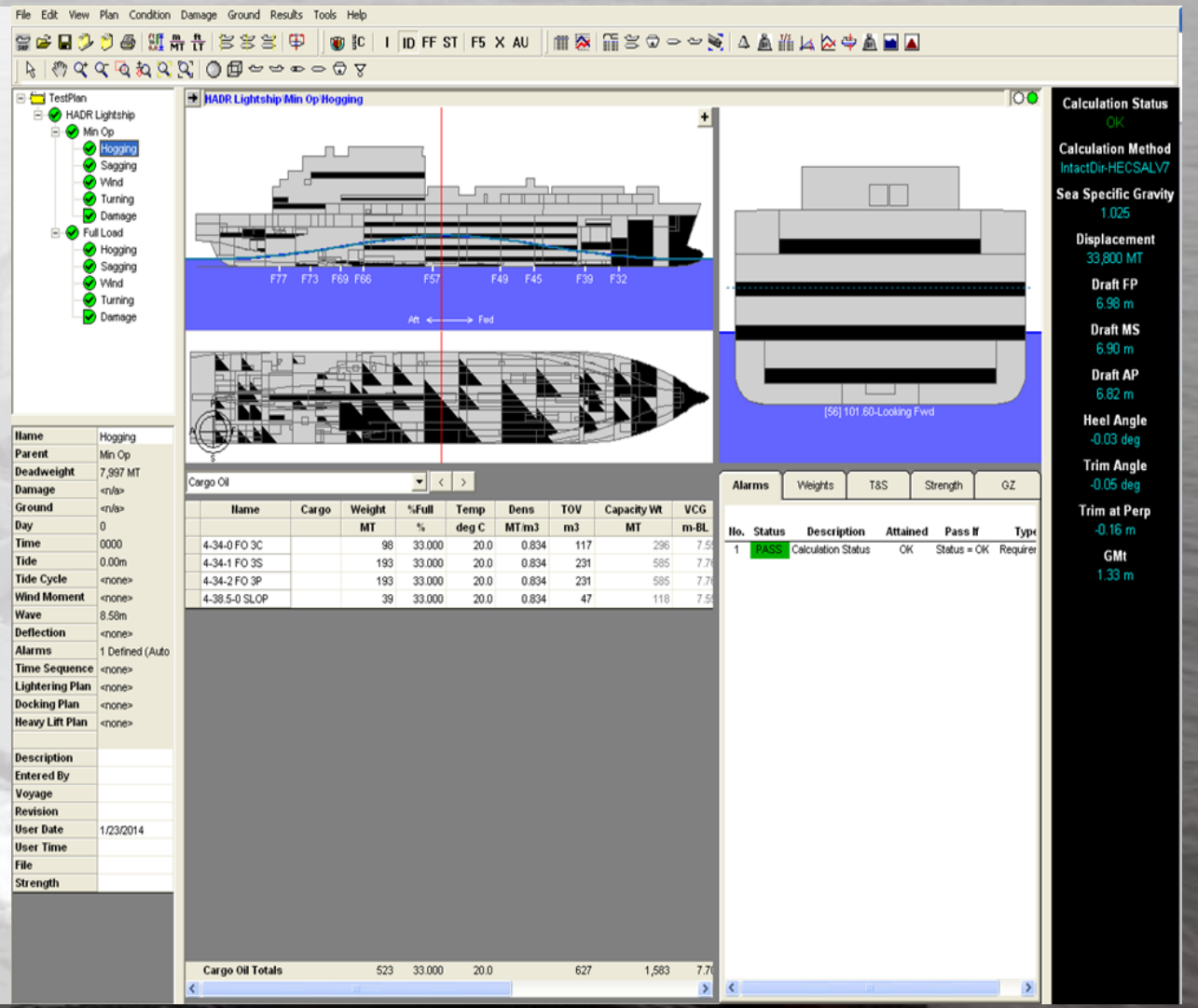
ASSET Model

POSSE Model

3D Rhino Model

MSC Technical Library

Ship Visit to T-AKE 13 (Norfolk, VA)



Design Study – Baseline T-AKE

LOA: 689 ft

Beam: 106 ft

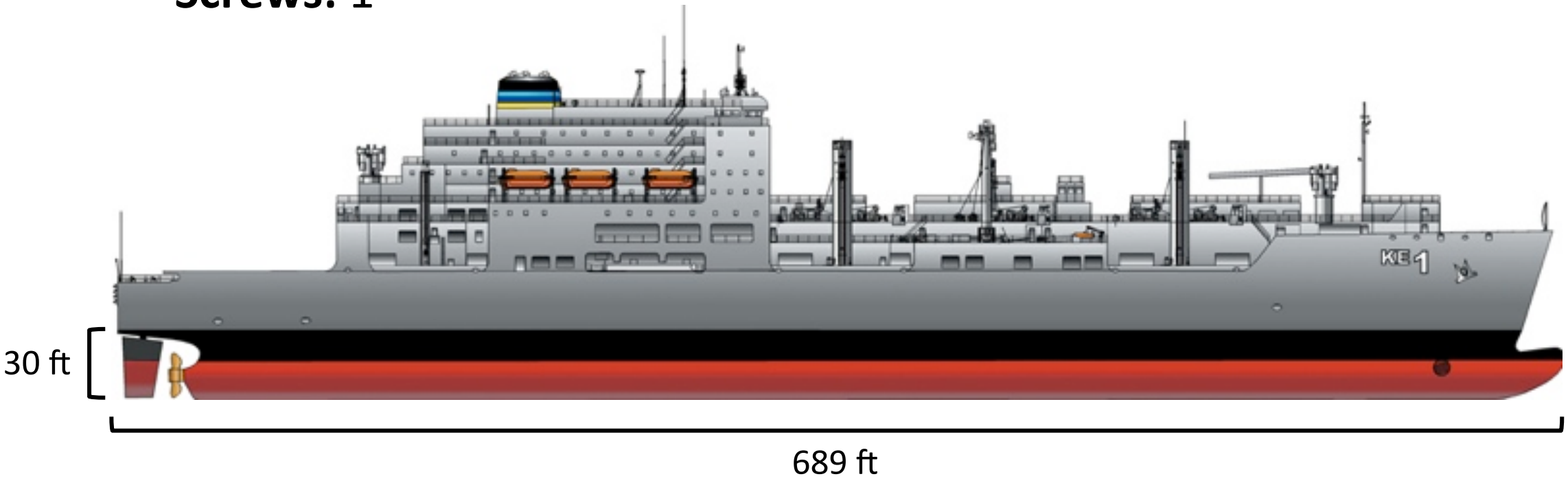
Draft: 30 ft

Screws: 1

Displacement:

Lightship – 26,000 MT

Full Load – 43,000 MT



Design Study – Baseline T-AKE

Electrical

- Diesel-electric IPS
- 4 Fairbanks-Morse/MAN DG sets, 34.7 MW (rated) combined
- 6.6 kV, 60 Hz distribution

Design Study – Baseline T-AKE

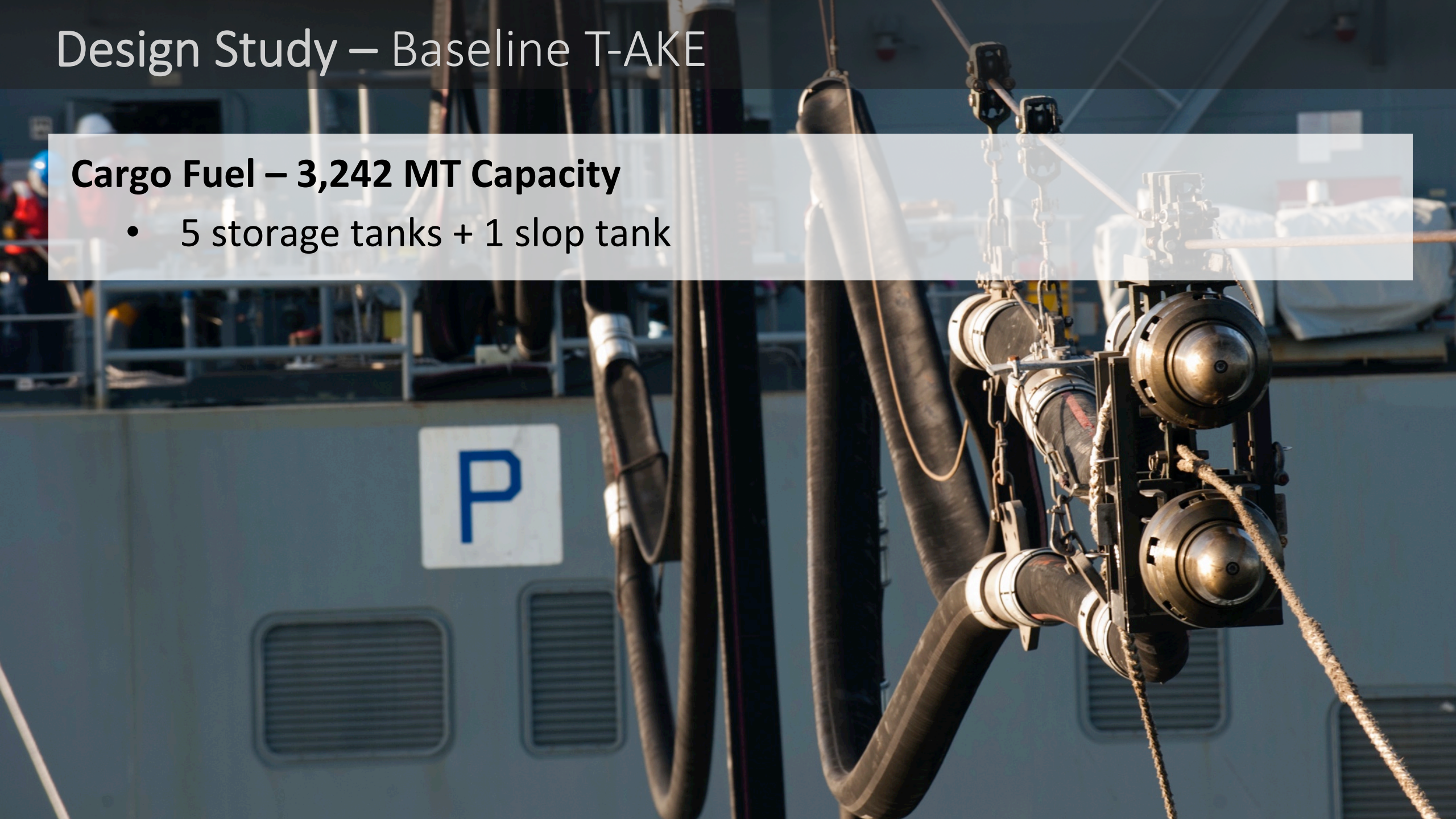
Dry Cargo – 6,675 MT Capacity

- 8 dry cargo spaces (2 compartments, 4 decks)
- 3 chilled/frozen stores spaces (1 compartment, 3 decks)

Design Study – Baseline T-AKE

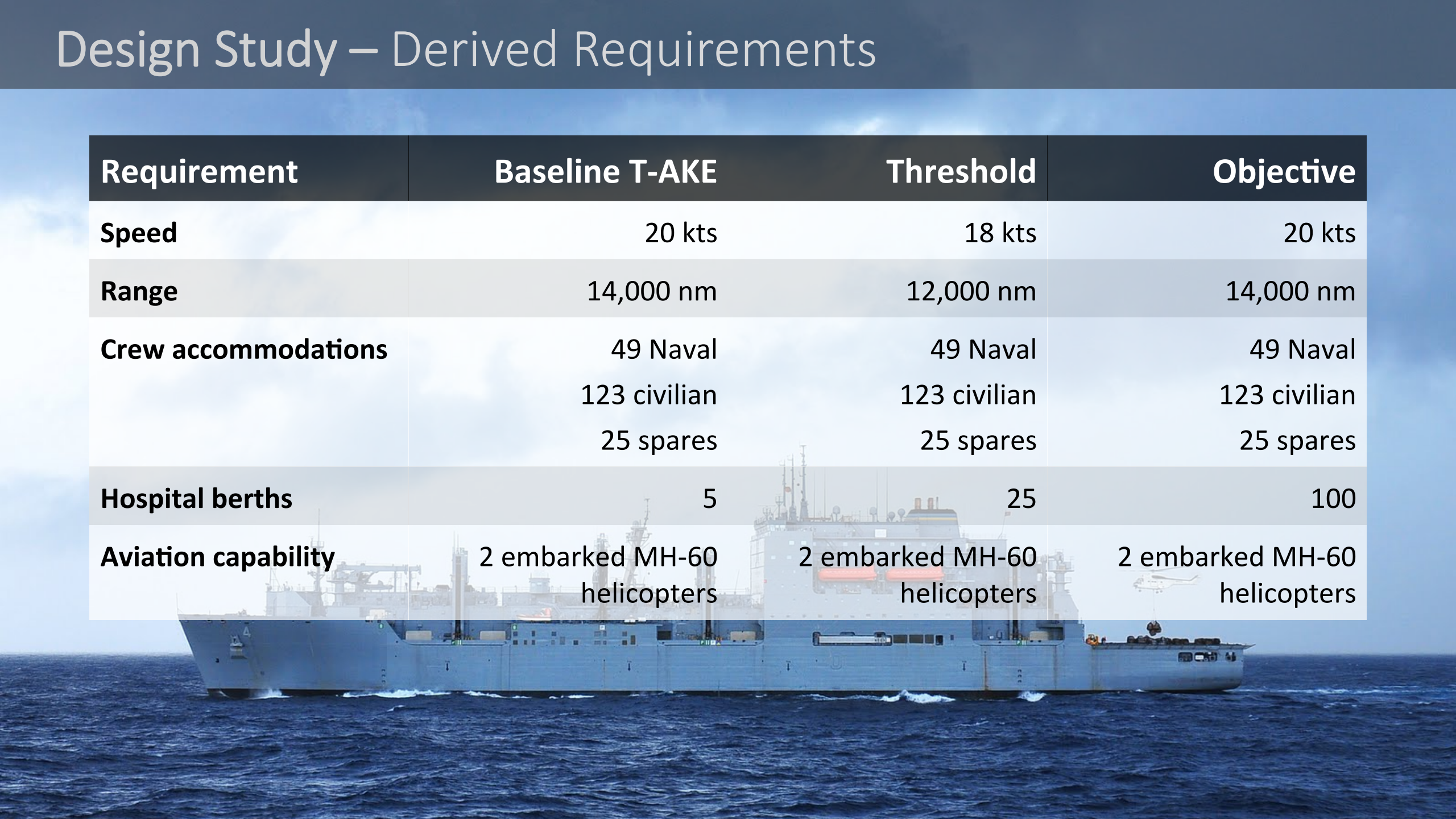
Cargo Fuel – 3,242 MT Capacity

- 5 storage tanks + 1 slop tank



Design Study – Derived Requirements

Requirement	Baseline T-AKE	Threshold	Objective
Speed	20 kts	18 kts	20 kts
Range	14,000 nm	12,000 nm	14,000 nm
Crew accommodations	49 Naval 123 civilian 25 spares	49 Naval 123 civilian 25 spares	49 Naval 123 civilian 25 spares
Hospital berths	5	25	100
Aviation capability	2 embarked MH-60 helicopters	2 embarked MH-60 helicopters	2 embarked MH-60 helicopters



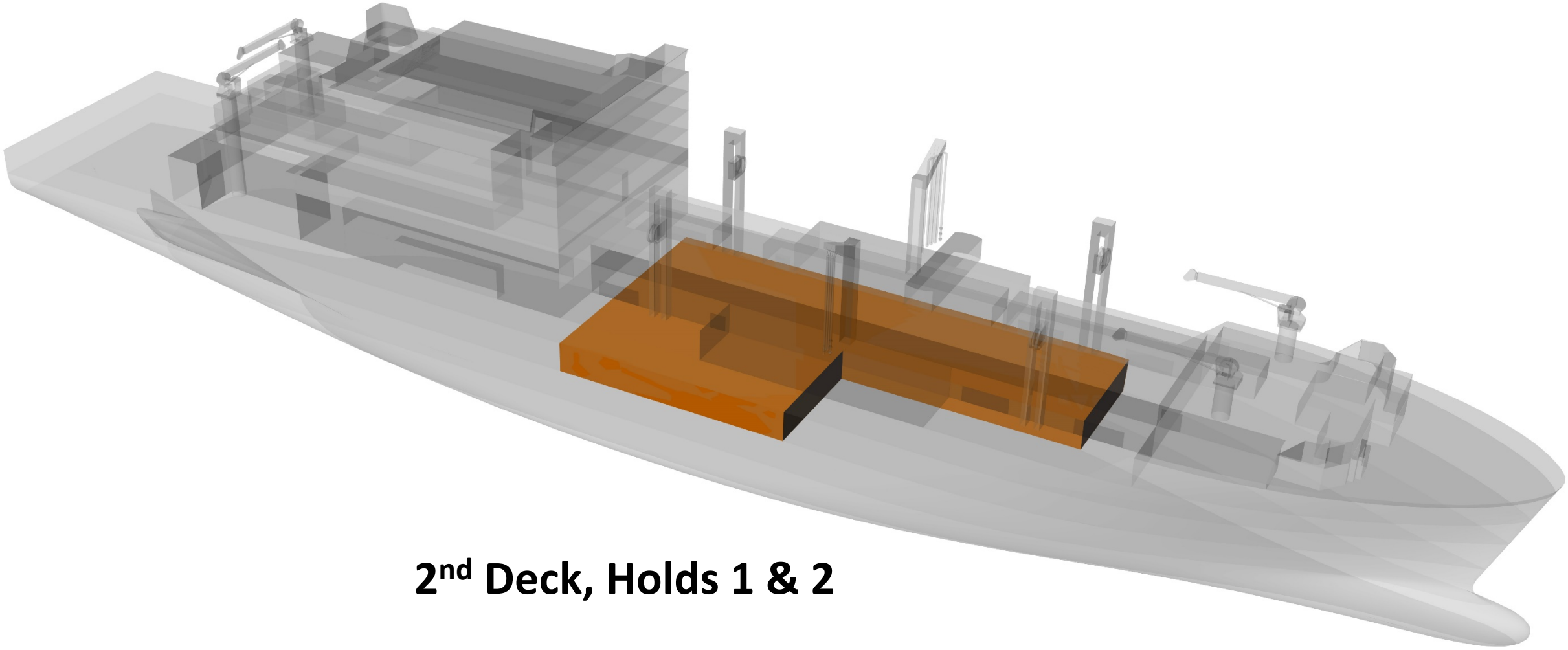
Design Study – Derived Requirements

Requirement	Baseline T-AKE	Threshold	Objective
Dry cargo capacity	6,675 MT	1,675 MT	5,000 MT
Cargo fuel capacity	3,242 MT	810 MT	2,432 MT
Off-hull Electrical Capacity	0 MW	25 MW	50 MW
Potable Generation Capacity	16,000 gpd	64,000 gpd	128,000 gpd
Potable Storage Capacity	200 MT (52,800 gal)	1,000 MT (270,000 gal)	2,000 MT (540,000 gal)
HA/DR Endurance	Variable	3 days	14 days

Variant Evaluation & Selection

	Variant				
	Weight	I	II	III	IV
MOE 1: HA/DR effectiveness	**0.67**				
MOP 1.1: Electrical generation capacity	10	0.00	0.00	1.00	1.00
MOP 1.2: Potable water generation capacity	10	0.00	1.00	0.00	1.00
MOP 1.3: Potable water storage capacity	8	0.00	1.00	0.00	1.00
MOP 1.4: Medical support capacity	8	1.00	1.00	1.00	1.00
MOE 2: UNREP effectiveness	**0.33**				
MOP 2.1: Dry cargo capacity	10	1.00	1.00	0.81	0.81
MOP 2.2: Cargo fuel capacity	10	0.98	0.38	0.98	0.38
MOP 2.3: Max speed	4	1.00	1.00	1.00	1.00
MOP 2.4: Max range	4	1.00	1.00	1.00	1.00
Overall Measure of Effectiveness		**14.5**	**26.6**	**20.6**	**30.7**

Mission Systems – Medical



2nd Deck, Holds 1 & 2

Mission Systems – Medical

104 hospital beds

5 exam rooms

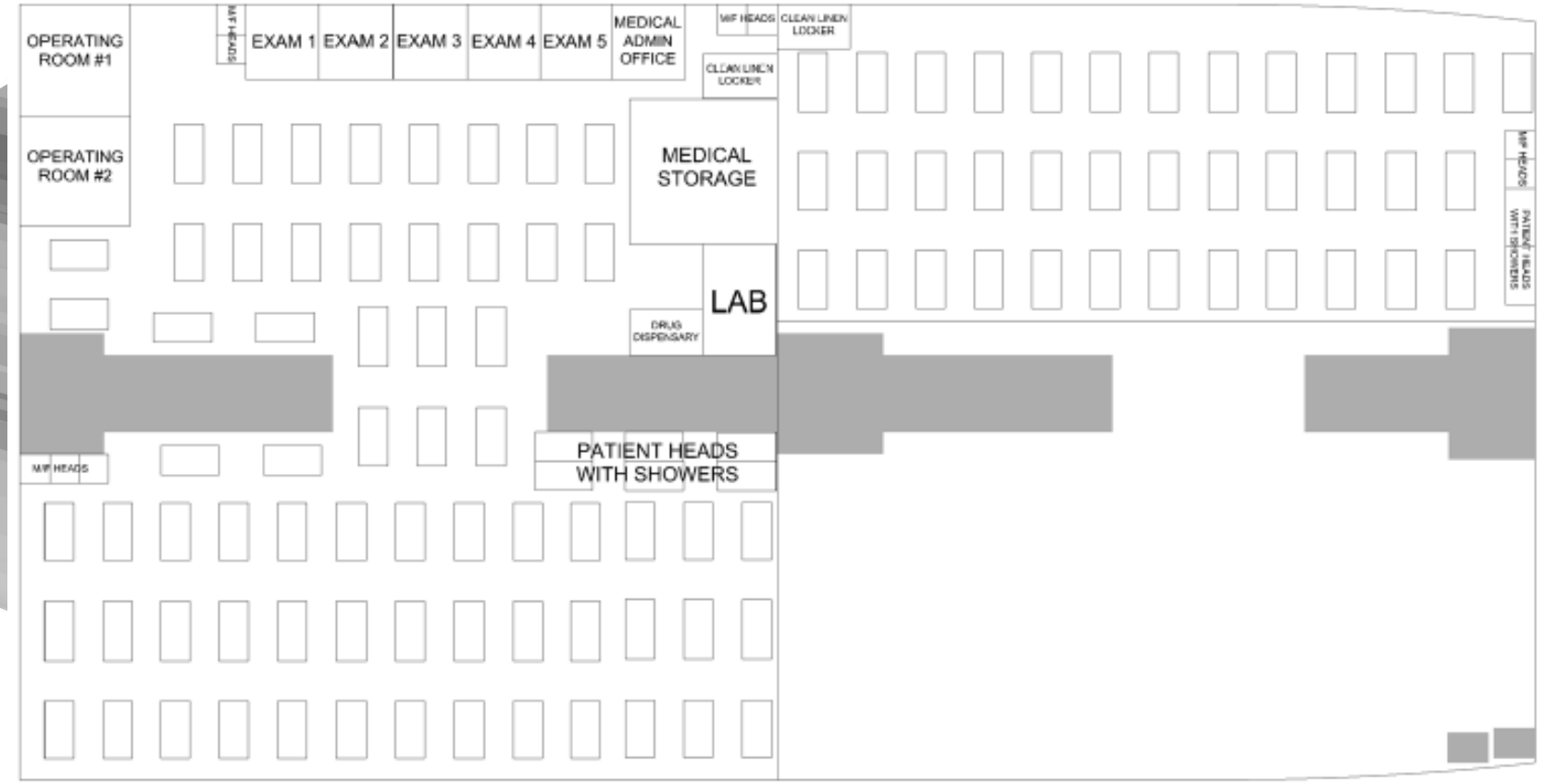
2 operating rooms

Medical lab

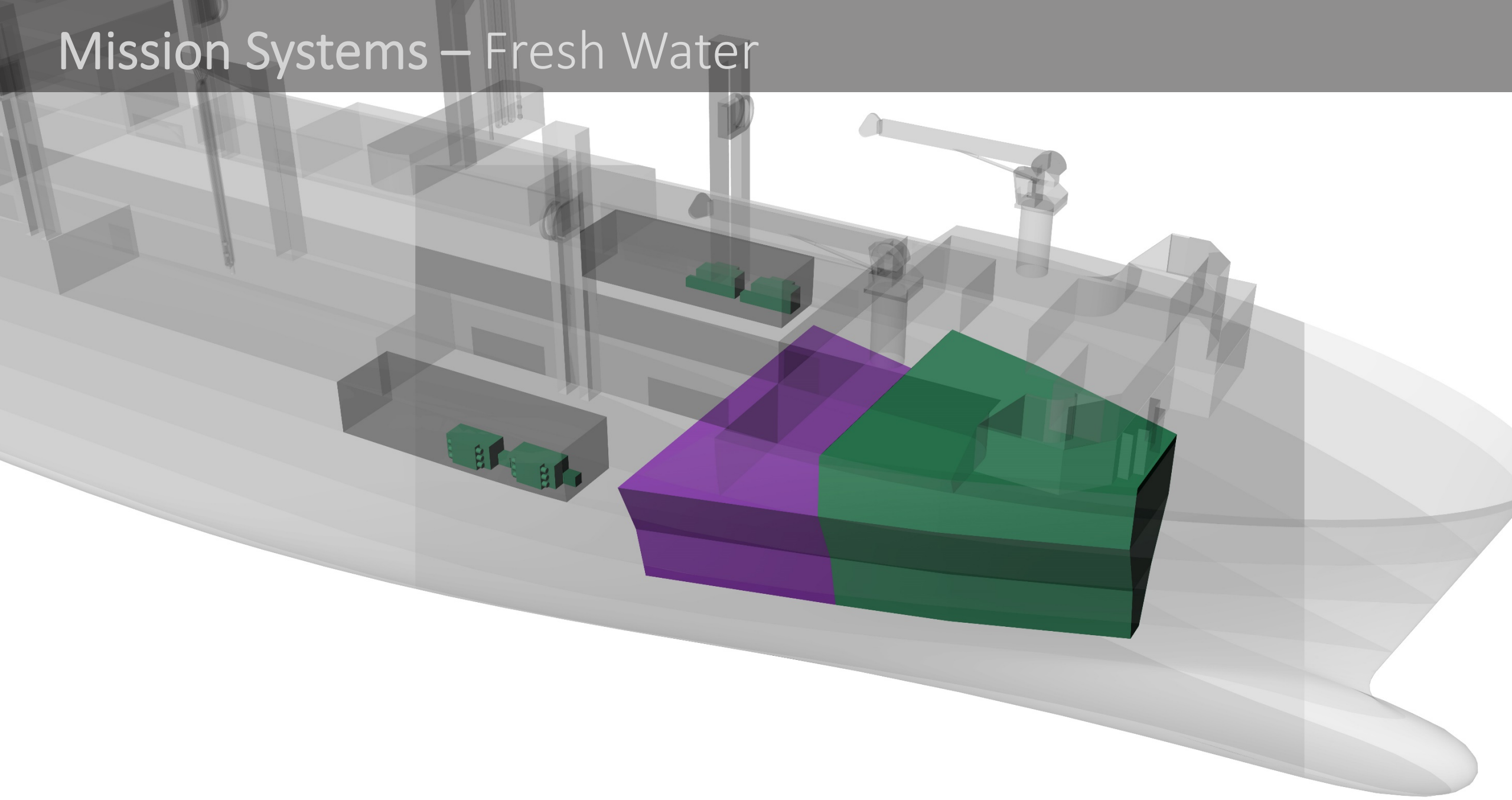
Dispensary

Medical storage

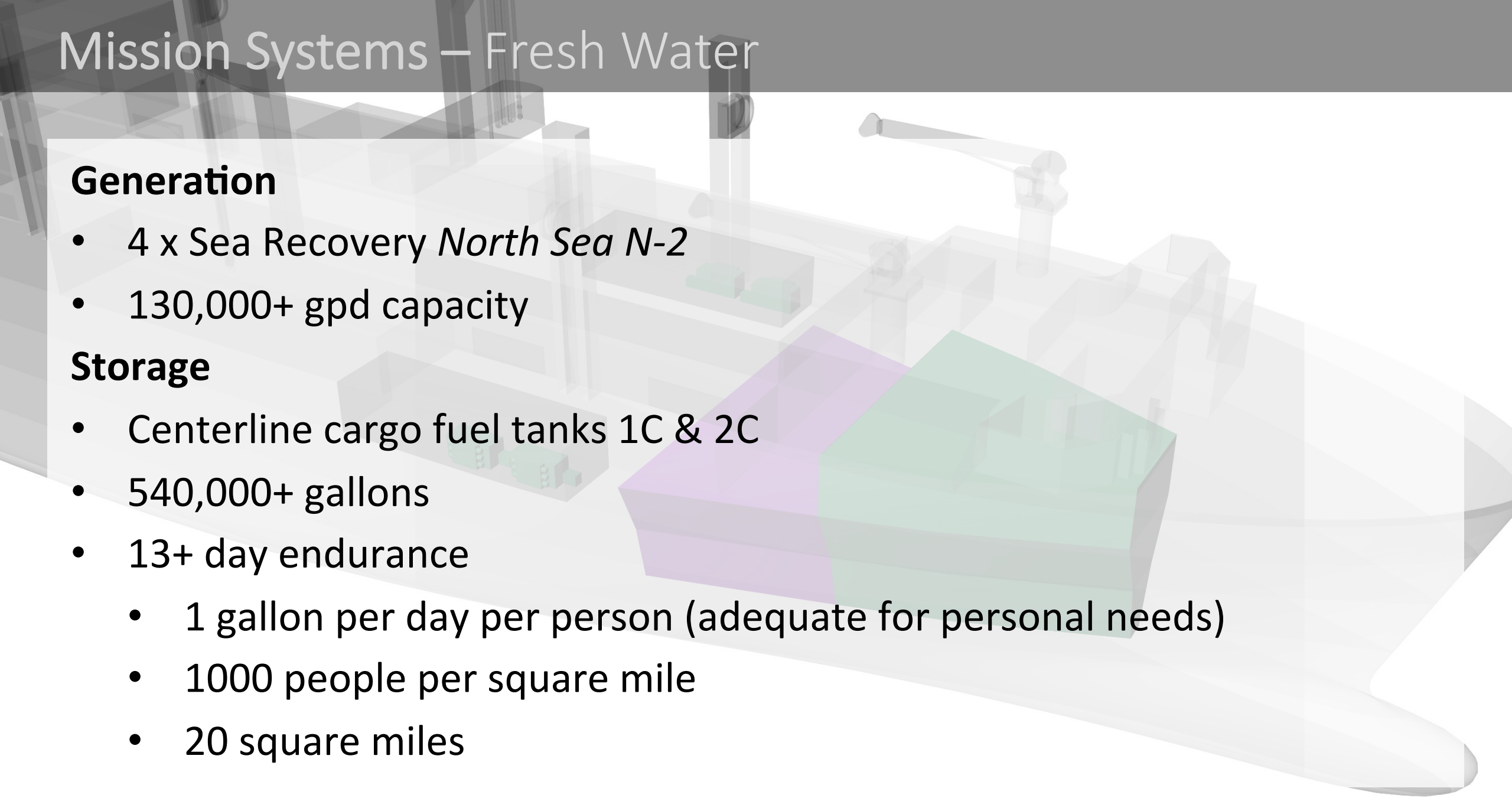
Multiple heads w/ showers



Mission Systems – Fresh Water



Mission Systems – Fresh Water



Generation

- 4 x Sea Recovery *North Sea N-2*
- 130,000+ gpd capacity

Storage

- Centerline cargo fuel tanks 1C & 2C
- 540,000+ gallons
- 13+ day endurance
  - 1 gallon per day per person (adequate for personal needs)
  - 1000 people per square mile
  - 20 square miles

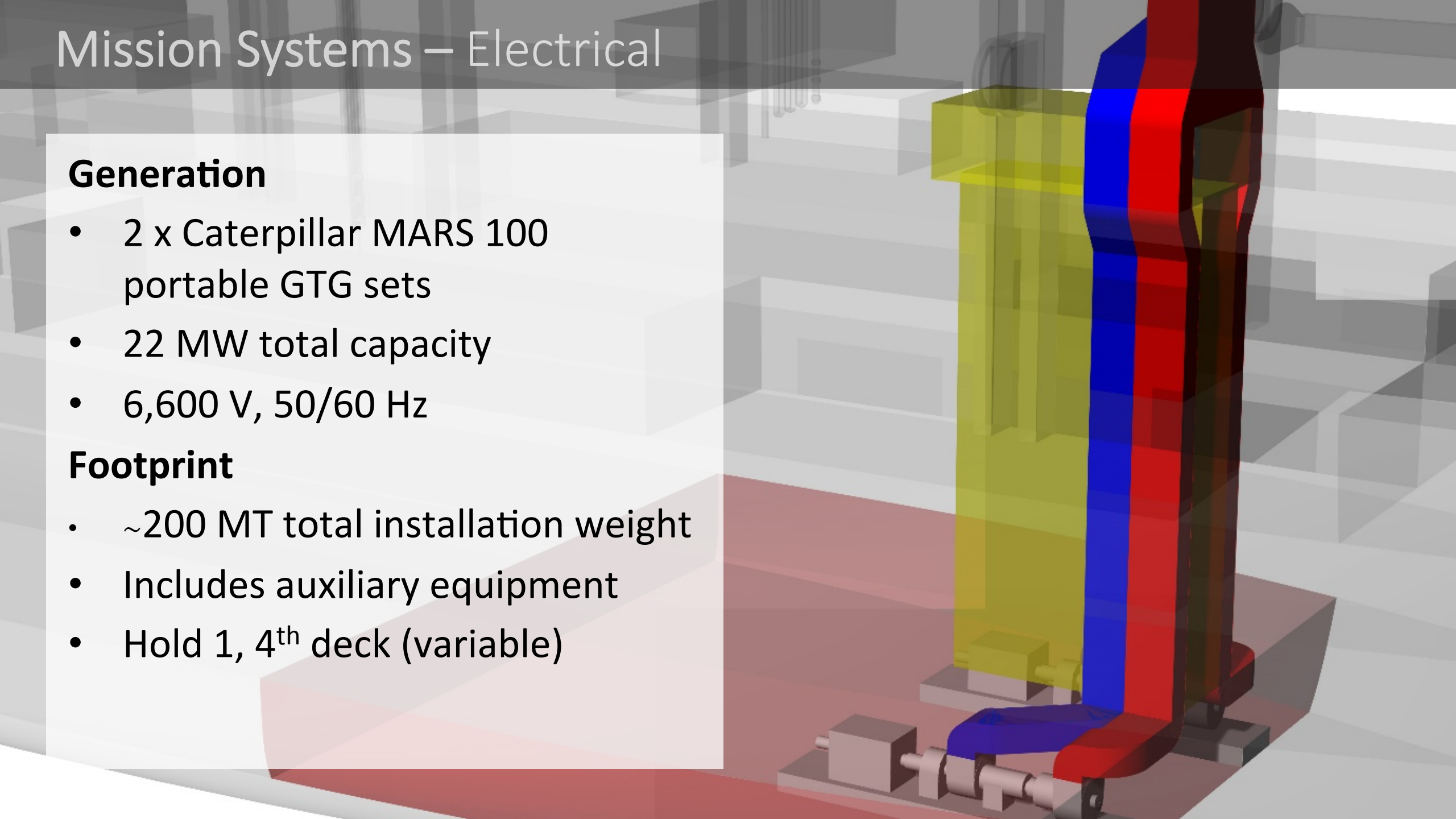
Mission Systems – Electrical

Generation

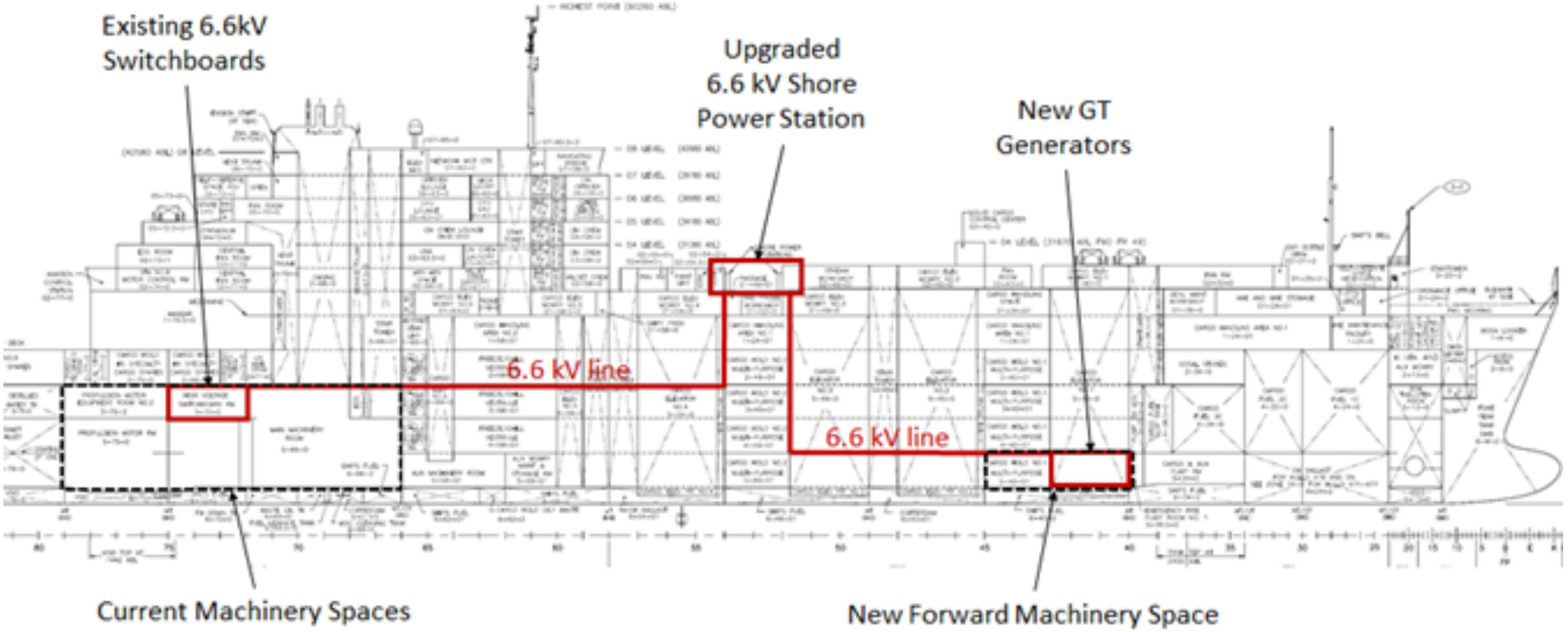
- 2 x Caterpillar MARS 100 portable GTG sets
- 22 MW total capacity
- 6,600 V, 50/60 Hz

Footprint

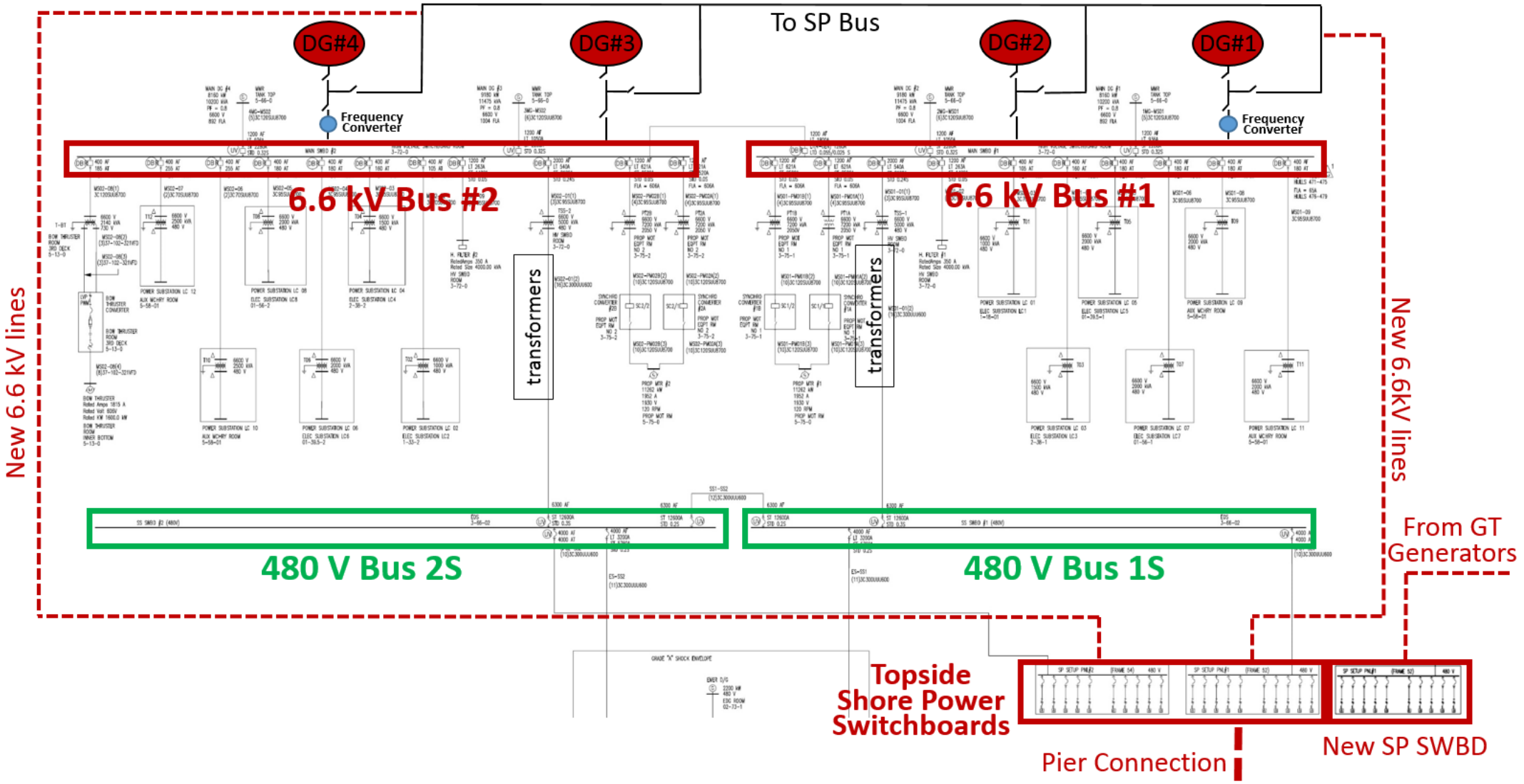
- ~200 MT total installation weight
- Includes auxiliary equipment
- Hold 1, 4th deck (variable)



HA/DR Power Delivery



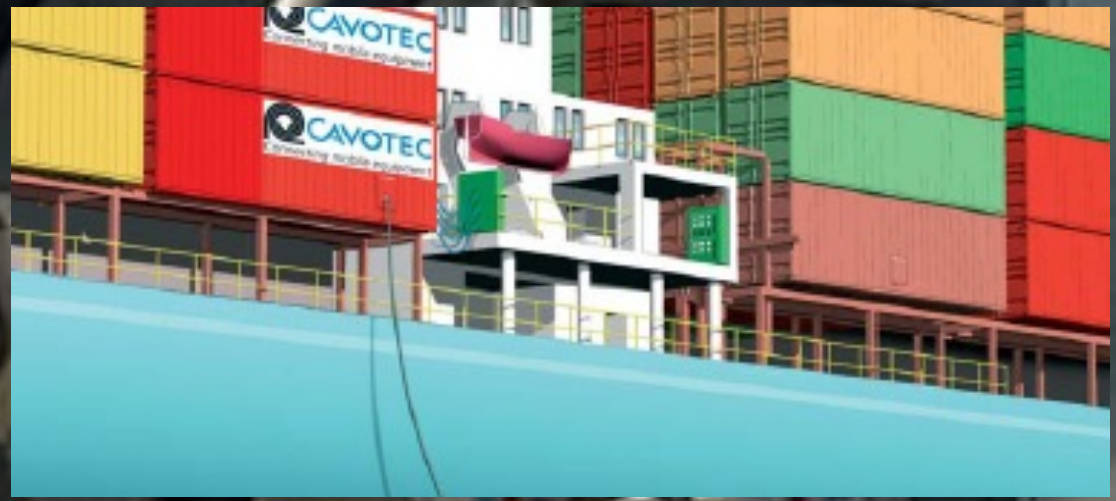
Mission Systems – Electrical



Mission Systems – Electrical

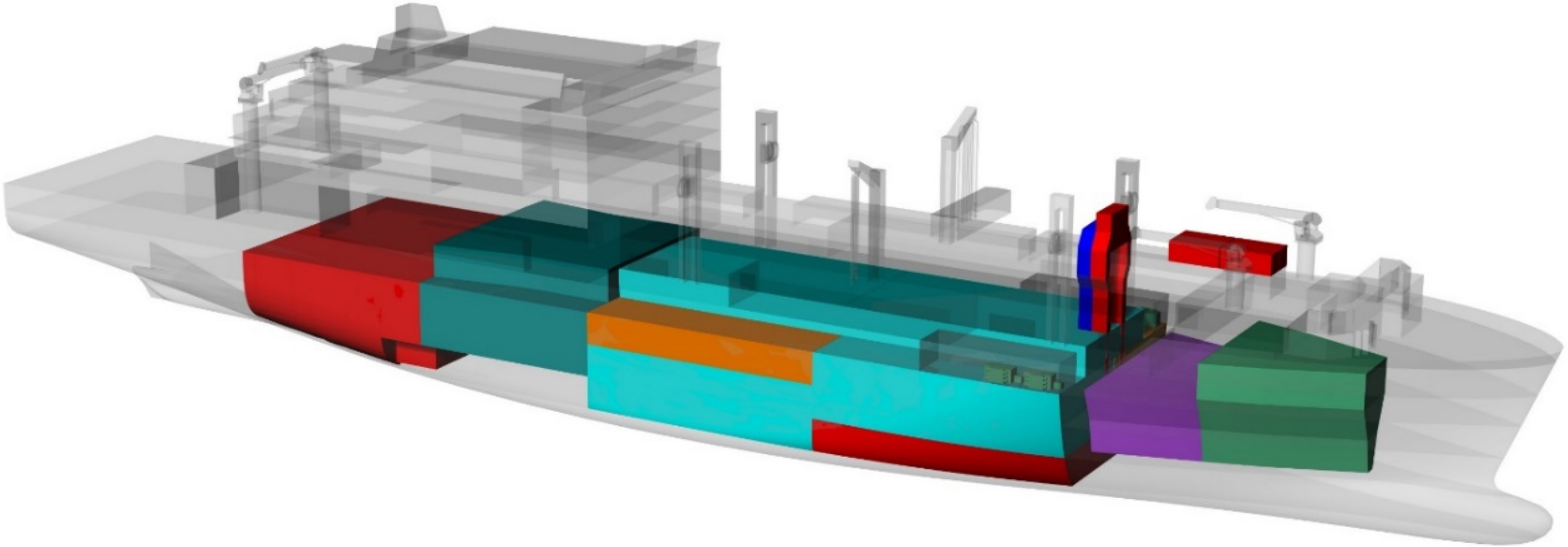
On-Pier Interface

- Allows interconnection with grid under credible scenarios
- Ship carries 20 ft interface boxes onboard and cranes them onto pier



Assumption: The ship can connect to existing grid under credible scenarios.

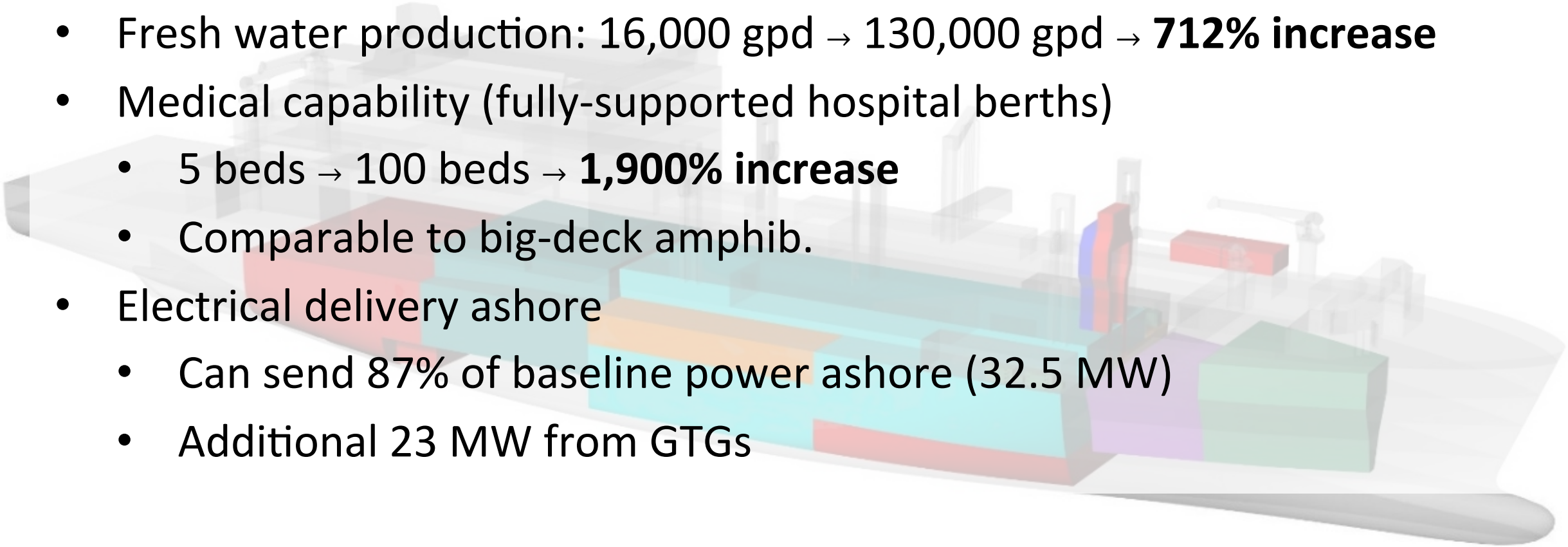
Final Concept Design – Summary



Final Concept Design – Comparative Analysis

HA/DR Mission

- Fresh water production: 16,000 gpd → 130,000 gpd → **712% increase**
- Medical capability (fully-supported hospital berths)
  - 5 beds → 100 beds → **1,900% increase**
  - Comparable to big-deck amphib.
- Electrical delivery ashore
  - Can send 87% of baseline power ashore (32.5 MW)
  - Additional 23 MW from GTGs



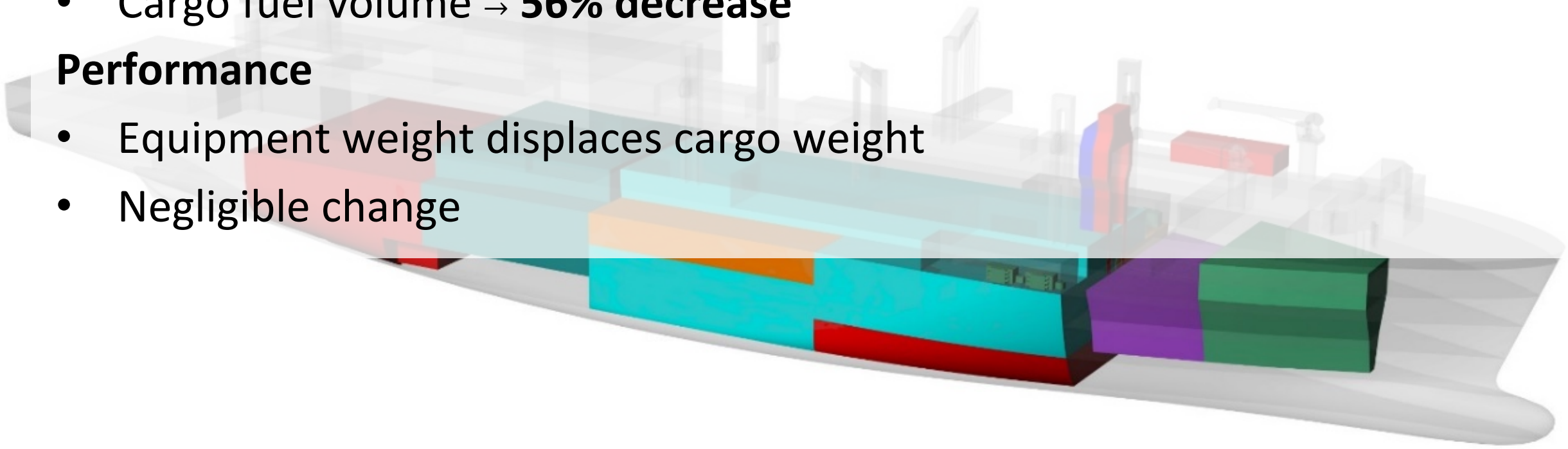
Final Concept Design – Comparative Analysis

UNREP Mission

- Dry cargo capacity → **35% decrease**
- Cargo fuel volume → **56% decrease**

Performance

- Equipment weight displaces cargo weight
- Negligible change



Conclusions & Recommendations

Feasibility depends on the ability to interface with existing grid.

- Define a useful set of specific connection capabilities.
- Design the conversion around the electrical system.

The T-AKE has LOTS of space.

- Great potential for less technically-complicated conversion.
  - Shelter/Medical facilities
  - Water production (even without storage)
  - Command & Control/Relief/NGO spaces

Future Work:

- More detailed cost estimate

Questions