

SEPT 2021

WASHINGTON STATE FERRIES' HYBRID EVOLUTION.



INTRO

NICE TO MEET YOU.

SEAN CAUGHLAN, PE
Senior Marine Engineer, Glosten



ABOUT US

WHAT WE DO BEST.



- Naval architecture
- Marine engineering
- Ocean engineering/analysis



- Electrical engineering
- Production engineering



- Marine civil construction
- Noise control engineering

WSF PROJECT TEAM & ROLES.



SIEMENS ENERGY

Prime Consultant; Propulsion SSV



GLOSTEN

Sub Consultant; Vessel Design Integration



STEMMANN-TECHNIK

Sub Consultant; Medium Voltage Charging

WSF SYSTEM-WIDE ELECTRIFICATION.

20-YEAR PLANNING HORIZON

- Technology Assessment
- Vessel Requirements & Feasibility Analysis
- Terminal Requirements & Feasibility Analysis
- Construction Project Schedule
- Workforce Assessment
- Financial Model
- Emissions Impact Estimate



GOALS

MEETING EMISSION REDUCTION REGULATIONS.

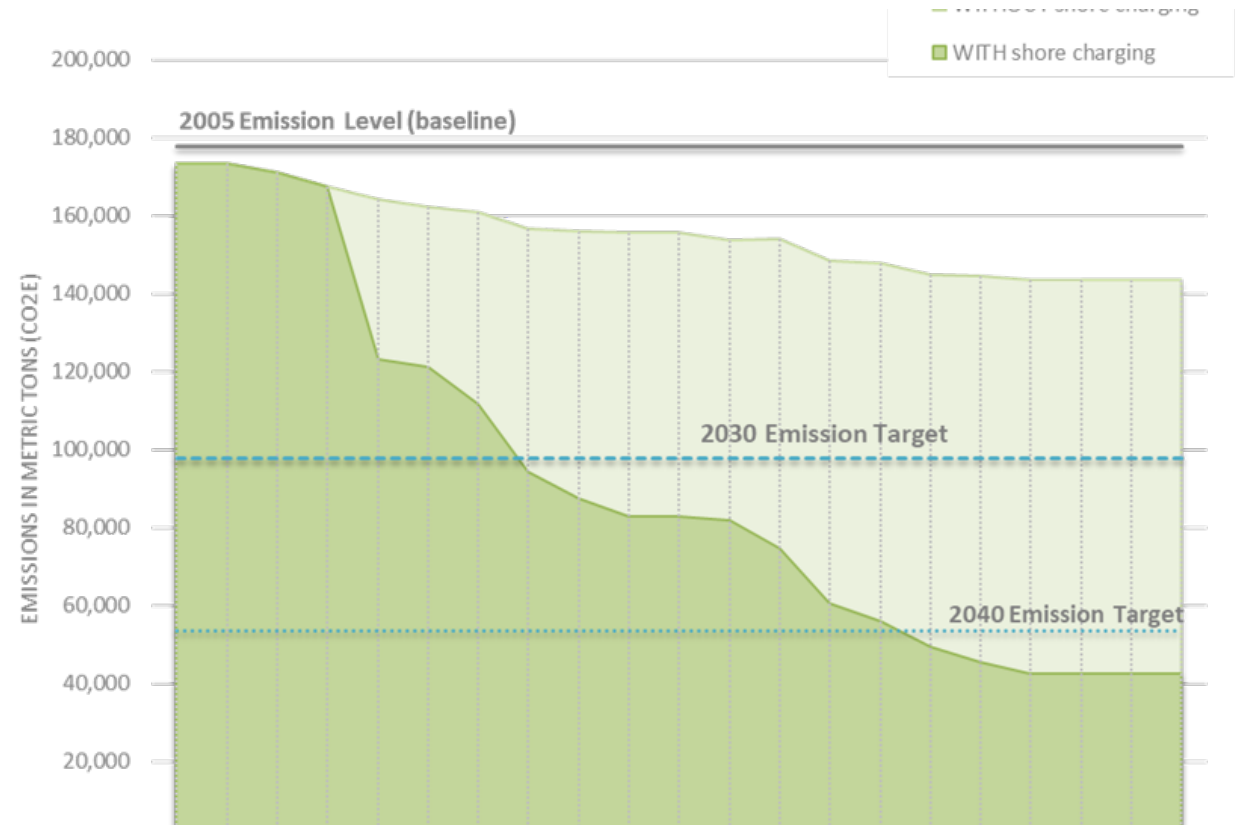
With Shore Charging

CO₂e reductions:

53% by 2030

76% by 2040

Meets requirements of RCW 70A.45.050.



GOALS

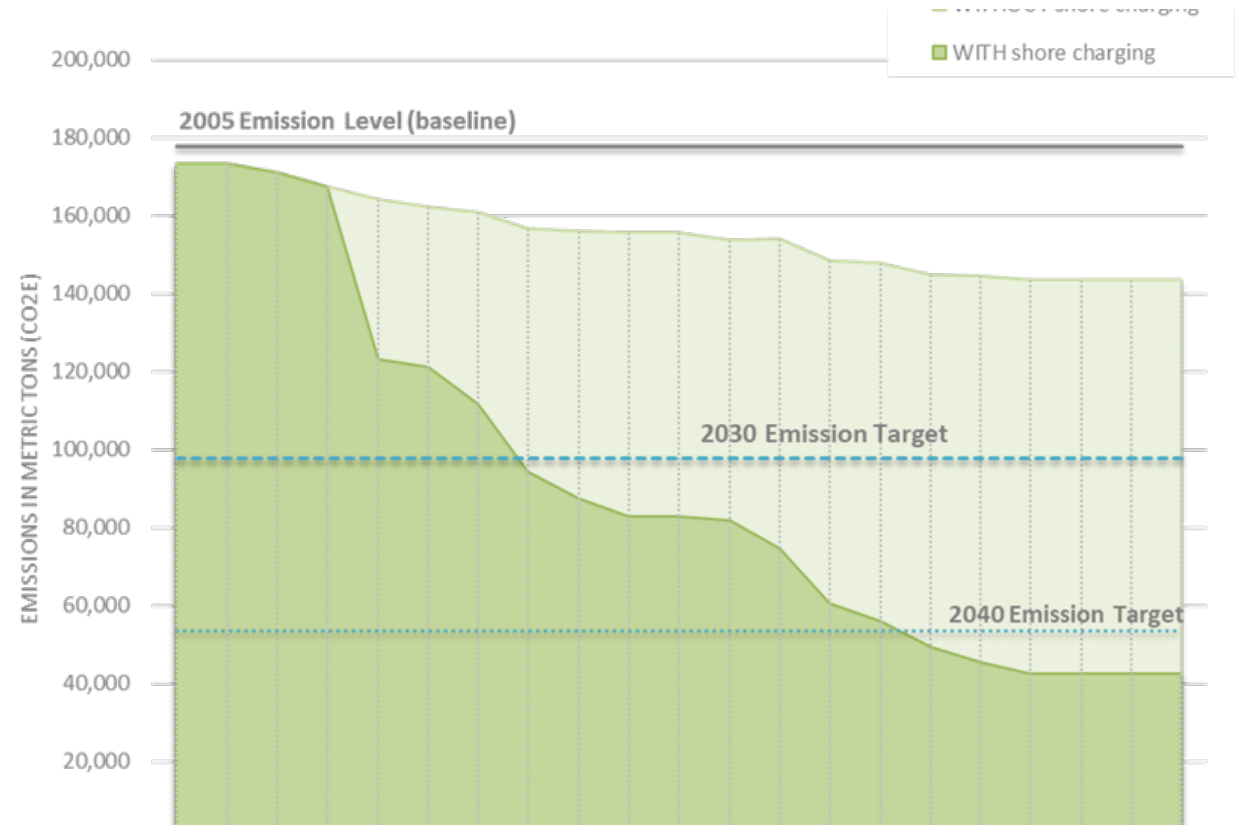
MEETING EMISSION REDUCTION REGULATIONS.

Without Shore Charging

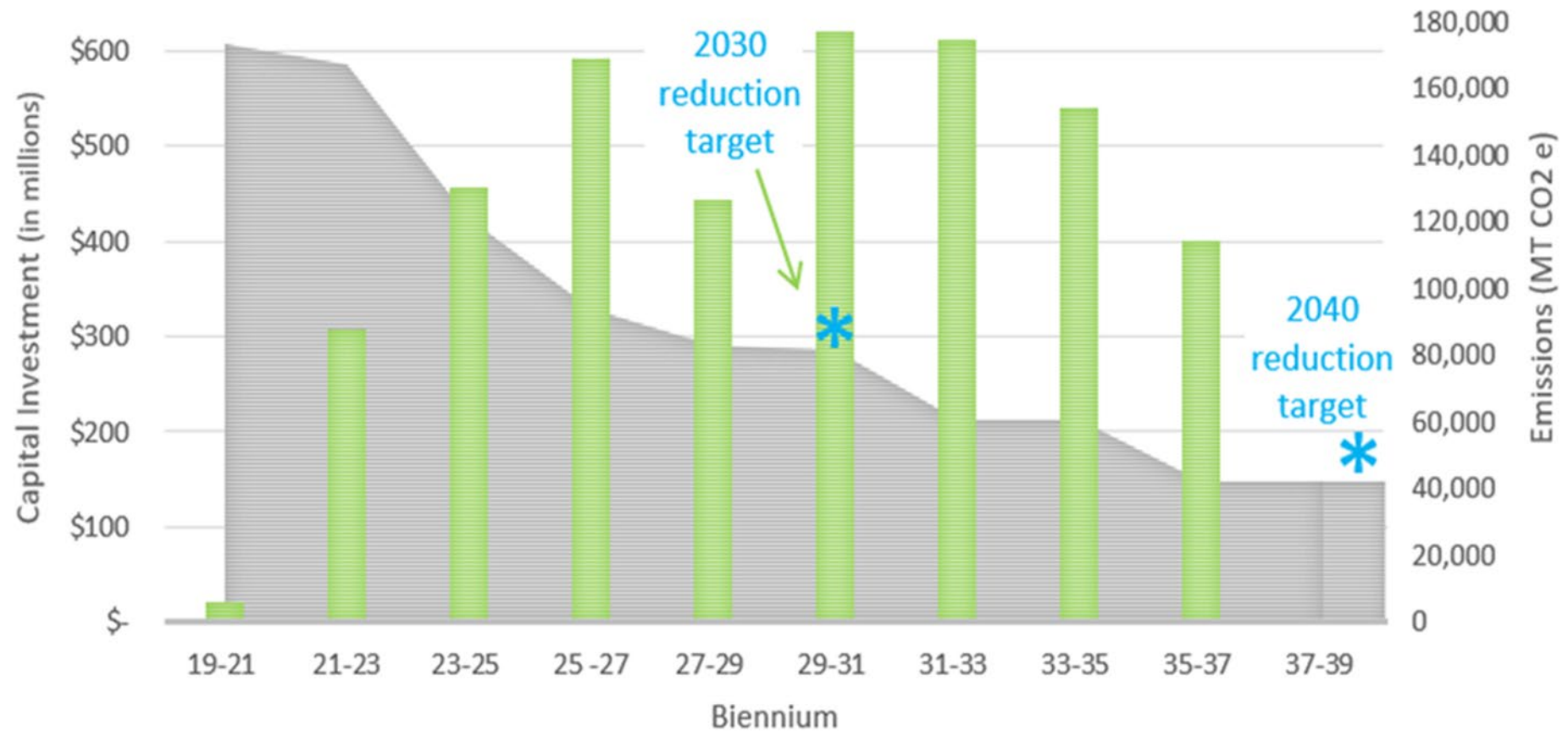
CO₂e reductions:

20% by 2040

Not compliant with RCW 70A.45.050.



EMISSIONS & CAPITAL INVESTMENT.

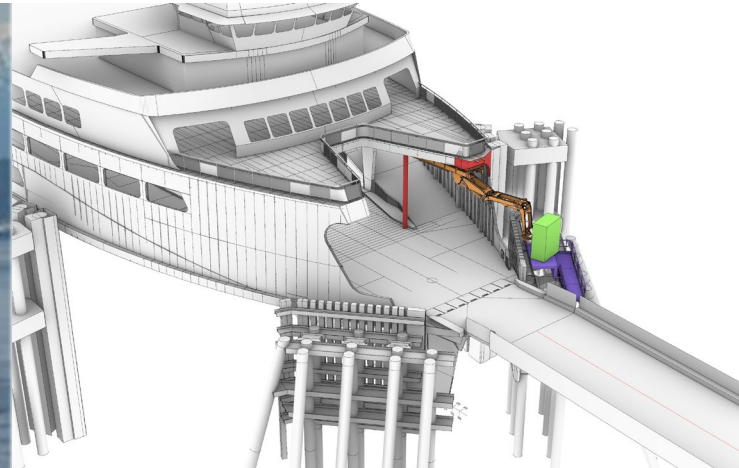


DESIGNS IN PROGRESS.



JUMBO MKII CONVERSION

- 460 ft long, 202 vehicle capacity
- 3 vessels, 2 routes
- 2 of 4 diesel engines removed
- 5.7 MW-Hr of energy storage
- 5 million gallons/yr fuel savings



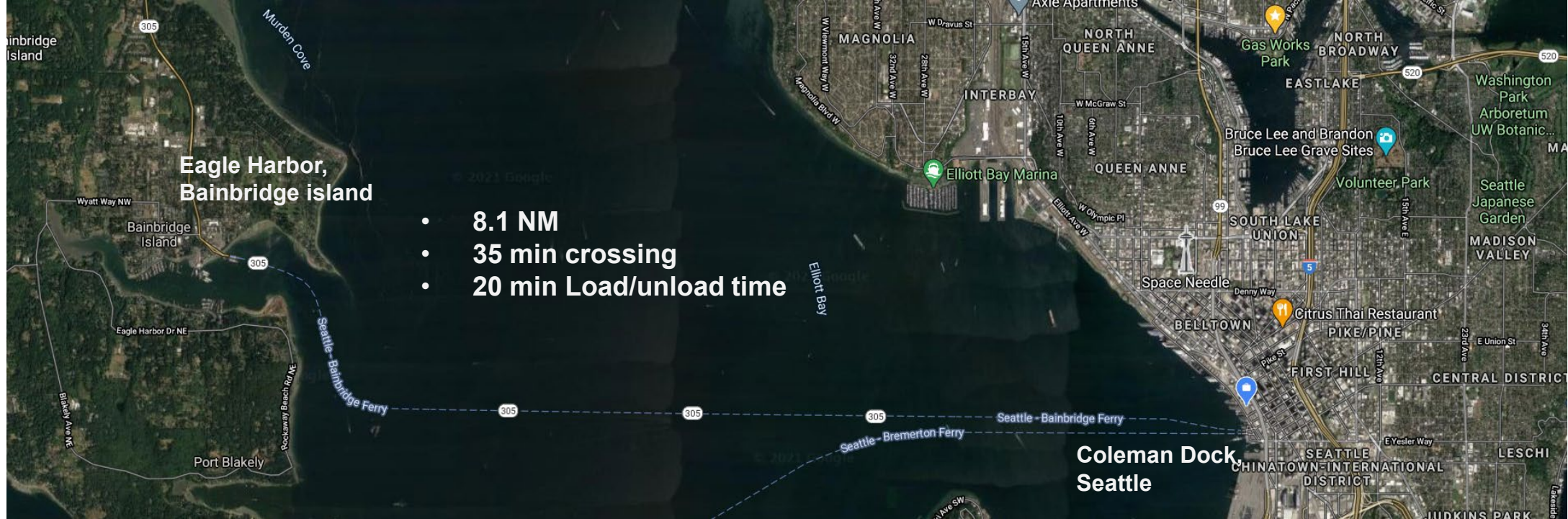
RAPID CHARGING SYSTEM

- 12.47 KV
- 15 MW maximum charging power
- 20 minutes available charging time
- 20 ft tidal range
- Minimal over-water construction



HYBRID-ELECTRIC OLYMPIC

- 5 vessels, 2 routes
- New propulsion design
- 9.9 MW-Hr of energy storage
- 5 Million gallons/yr fuel savings



- 8.1 NM
- 35 min crossing
- 20 min Load/unload time

JUMBO MKII PROJECT REQUIREMENTS.

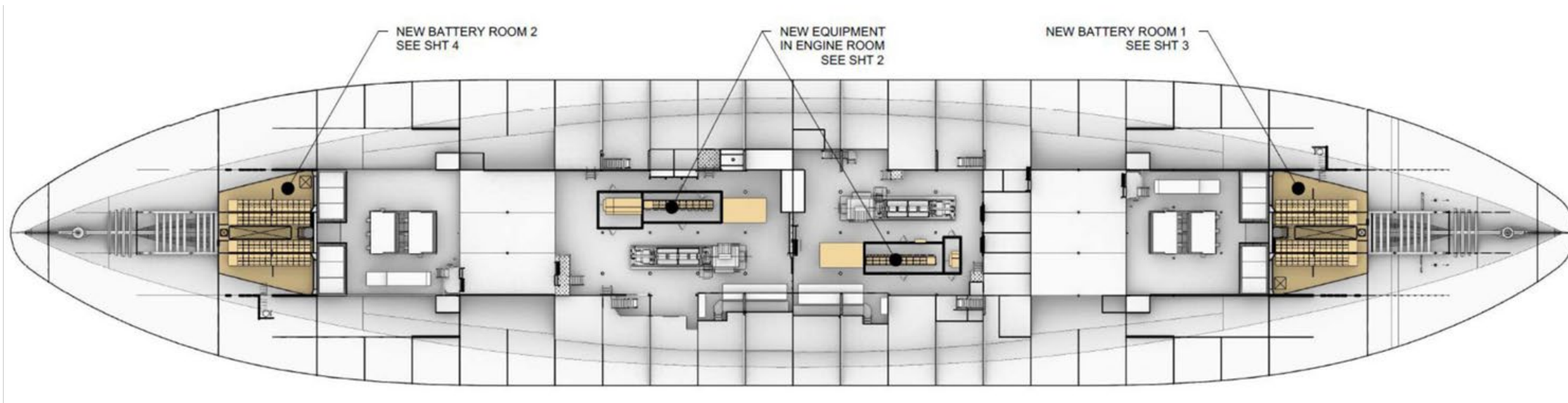
Two routes

- Seattle-Bainbridge Island (2200 kWh crossing energy)
- Edmonds-Kingston

Shore charging stations: Seattle, Bainbridge, Kingston

Charging system (10MW)

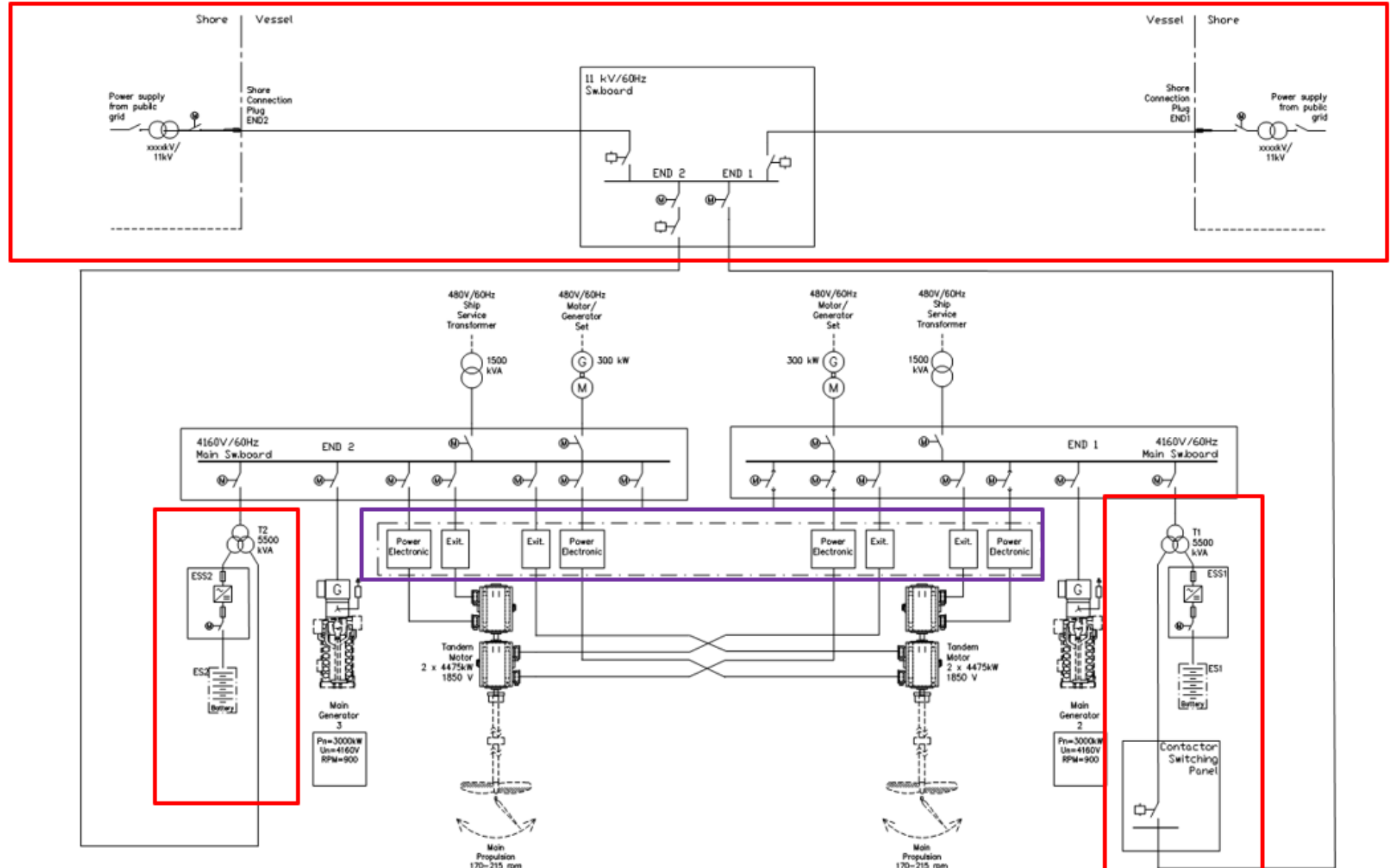
- Recover full trip energy with 90% availability (~8,800 kW)
- Power for pushing the dock (~800 kW)
- Hotel power (~400 kW)



JUMBO MKII CONVERSION.

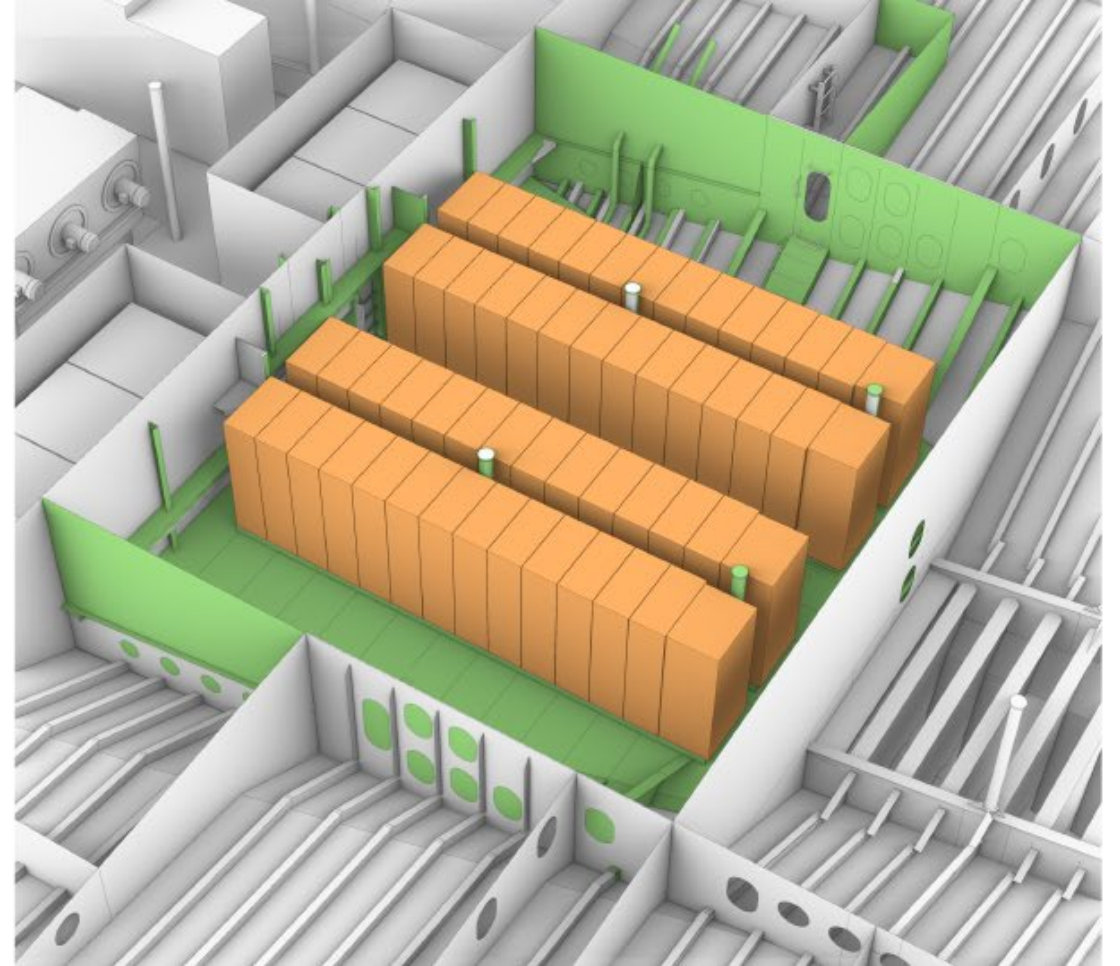
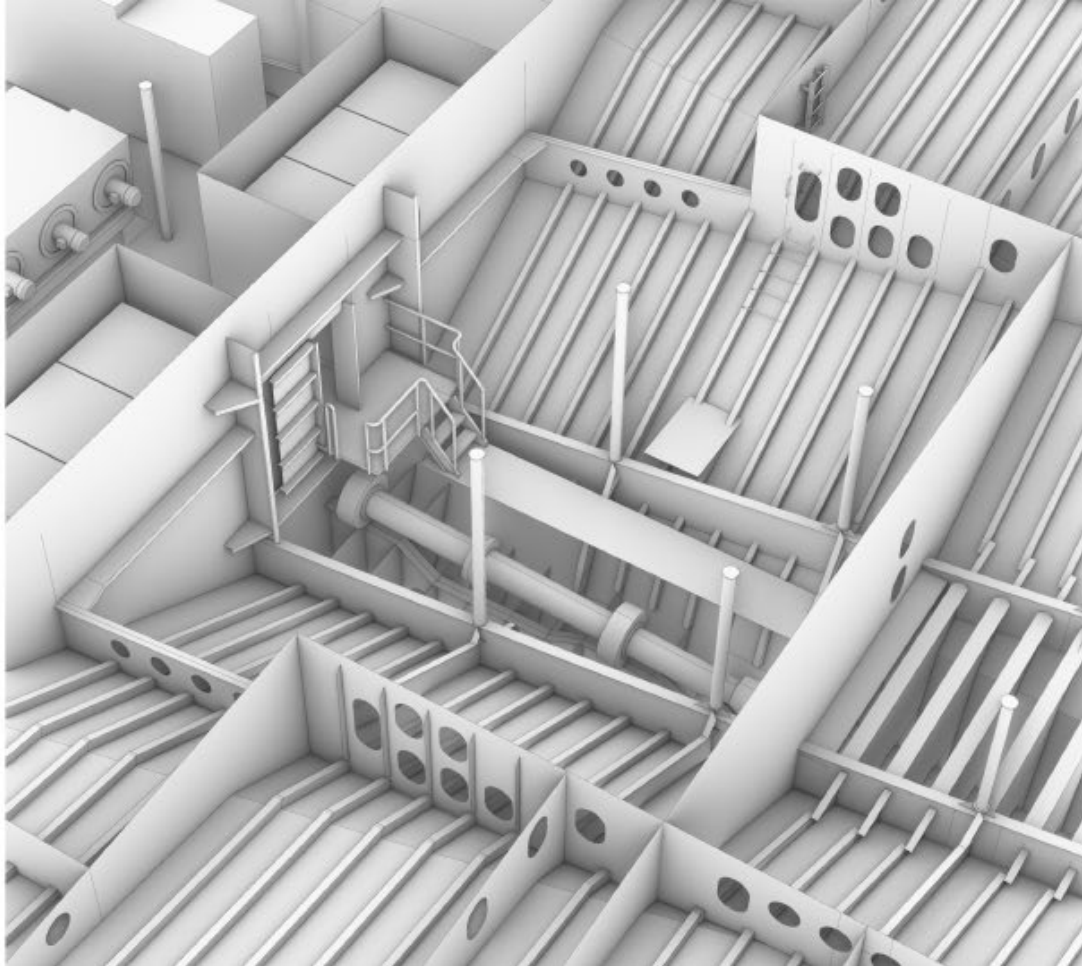
- Siemens Design complete pending US Coast Guard approval
- Vessel #1 funded by VW Mitigation Fund, CMAQ, and MARAD
- Construction for vessel #1 scheduled for Oct 2022 - March 2023
- Two remaining vessels and terminal construction yet to be funded

JUMBO MARK II UPGRADE – SINGLE LINE.



Siemens Marine Solutions provided the original Propulsion, Drives, and Control Systems on the Jumbo Mark IIs.

BATTERY ROOM ARRANGEMENTS.



RULES AND REGULATIONS.

USCG Regulations

- 46 CFR § Part 70-80 Subchapter H Passenger Vessels
- USCG Policy Letter 02-19, Design Guidance for Lithium-Ion Battery Installation onboard Commercial Vessels;
 - Standard Guide for Shipboard Use of Lithium-Ion (Li-ion) Batteries, ASTM International, F3353-19

Design Guidance (WSF)

- Marine Vessel Rules, American Bureau of Shipping (ABS), 2020
- Use of Lithium-Ion Batteries in the Marine and Offshore Industries, ABS, February 2020

Battery Certification

- DNV-GL and ABS Type Approval



GUIDE FOR

USE OF LITHIUM BATTERIES IN THE MARINE AND OFFSHORE INDUSTRIES FEBRUARY 2020

U.S. Department of
Homeland Security
United States
Coast Guard



Commandant
United States Coast Guard

2703 Martin Luther King Jr Ave SE
Mail Stop 7509
Washington, DC 20593-0001
Staff Symbol: CG-ENG


From: R. C. Compher, CAPT
COMDT (CG-ENG)

To: Distribution

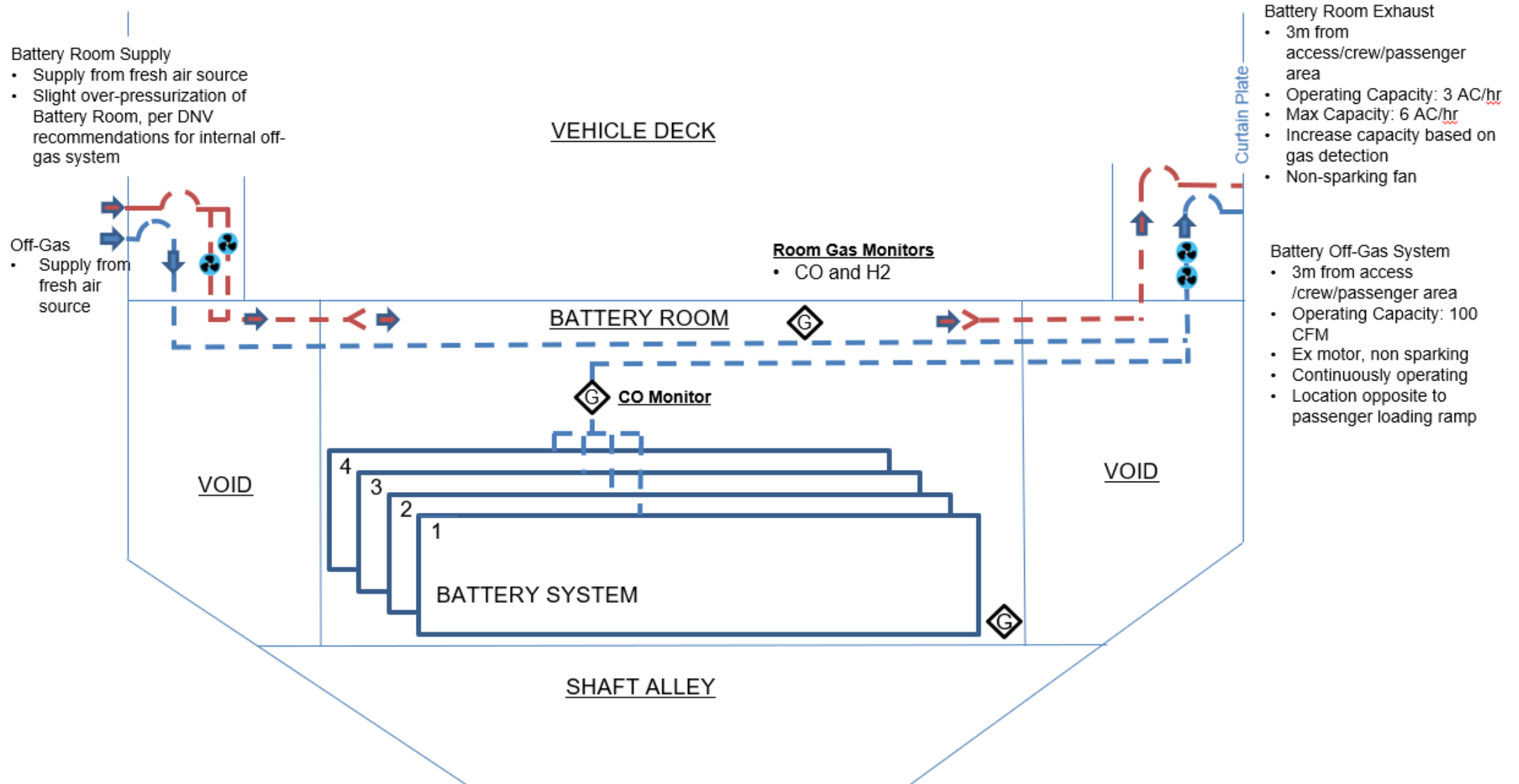
Subj: DESIGN GUIDANCE FOR LITHIUM-ION BATTERY INSTALLATIONS
ONBOARD COMMERCIAL VESSELS

Ref: (a) Title 46 Code of Federal Regulations (CFR) Subchapter J
(b) Standard Guide for Shipboard Use of Lithium-Ion Batteries, ASTM F3353-19

16715
CG-ENG-Policy Letter
No. 02-19
October 2, 2019

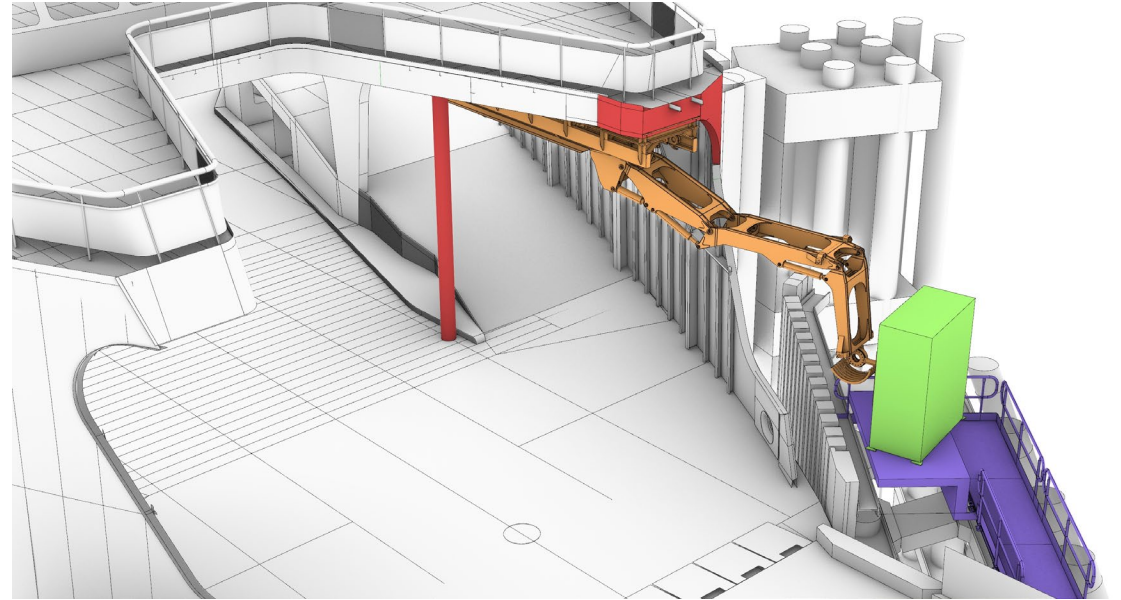
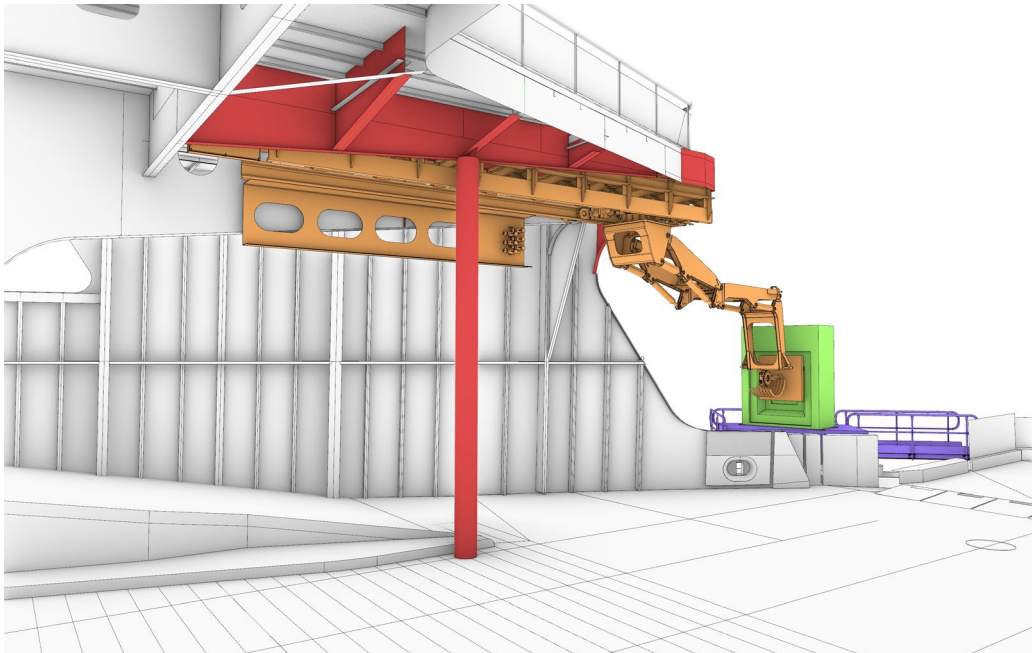
1. **Purpose.** There is increased interest in Lithium-ion (Li-ion) batteries and other new types of stored energy technology onboard U.S. flag inspected vessels. Unique safety concerns are associated with these technologies and the plan review process can be lengthy due to system complexities and the lack of published regulations or marine standards on the topic. This policy establishes design guidance for commercial vessels using Li-ion batteries within the existing regulatory framework. This document was drafted in collaboration with the Marine Safety Center in order to provide consistent guidance to designers of vessel electrical systems, and for USCG personnel reviewing those designs. The purpose of this guidance is to provide an acceptable method for using Li-ion battery technology that will result in a streamlined and consistent plan approval process. Other design concepts will be reviewed by the Marine Safety Center in collaboration with CG-ENG on a case-by-case basis.
2. **Directives Affected.** None.
3. **Action.** USCG Headquarters Units and Offices, Districts, and Sector Commanders may use this policy letter to ensure compliance with U.S. statutory and regulatory requirements.
4. **Background.**
 - a. Advances in energy storage technology have enabled new possibilities in shipboard power systems. Currently, lead-acid batteries comprise the vast majority of shipboard energy storage installations due to their low cost and predictable performance. Lithium based batteries are many times more energy dense, are becoming less expensive, and are making all-electric or hybrid electric power systems possible on some types of vessels.
 - b. Shipboard power systems can benefit from stored energy in a number of ways including, but not limited to, the following:

BATTERY ROOM VENTILATION DESIGN.



RAPID CHARGING SYSTEM.

- Developed under Jumbo MKII contract
- Intent for WSF fleet standard
- Integrated into Hybrid Electric Olympic design



Arm extending during charging operations (cabling and covering not shown)

- Automated connection
- Accommodates vessel motions and tides
- Minimizes over-water construction
- Adaptation of successful European designs

CALL TO ACTION & STRATEGIC ROADMAP.

- Governor's Executive Order 18-001
- State GHG Reduction Goals (RCW 70A.45.050)
- Long Range Plan submitted to legislature in January 2019
 - Reliable service
 - Customer experience
 - Manage growth
 - **Sustainability and resilience**



THANK YOU.

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