FOSS

THE HYBRID SOLUTION

Power And Reliability In A Green Package

January 10, 2012

ASPIN KEMP & ASSOCIATES

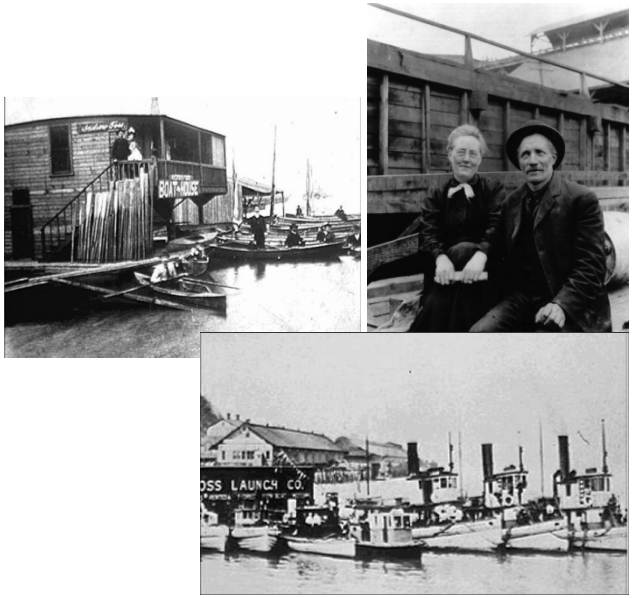
Aspin Kemp & Associates

- A Canadian based company specializing in the design and development of power, propulsion and control systems primarily in the marine and offshore oil and gas industries.
- Designed and manufactured the world's first hybrid tug.
- Developers of the Advanced Generator Protection (AGP) system.
- Operate a manufacturing and R&D facility in PEI with complete test lab and training facilities.

AKA - PRINCE EDWARD ISLAND

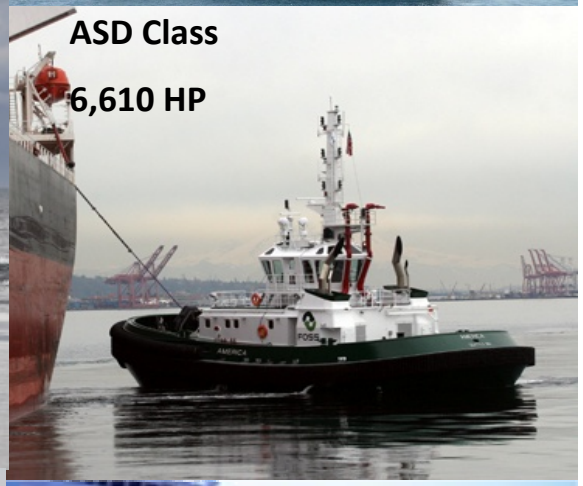
AKA - ONTARIO

Foss Maritime Company



- Founded in 1889
- West Coast and Global
- Two Shipyards
- 50 tugs; 70 barges
- 3,000-8,000 hp tugs
- Headquartered in Seattle

The Foss Harbor Fleet



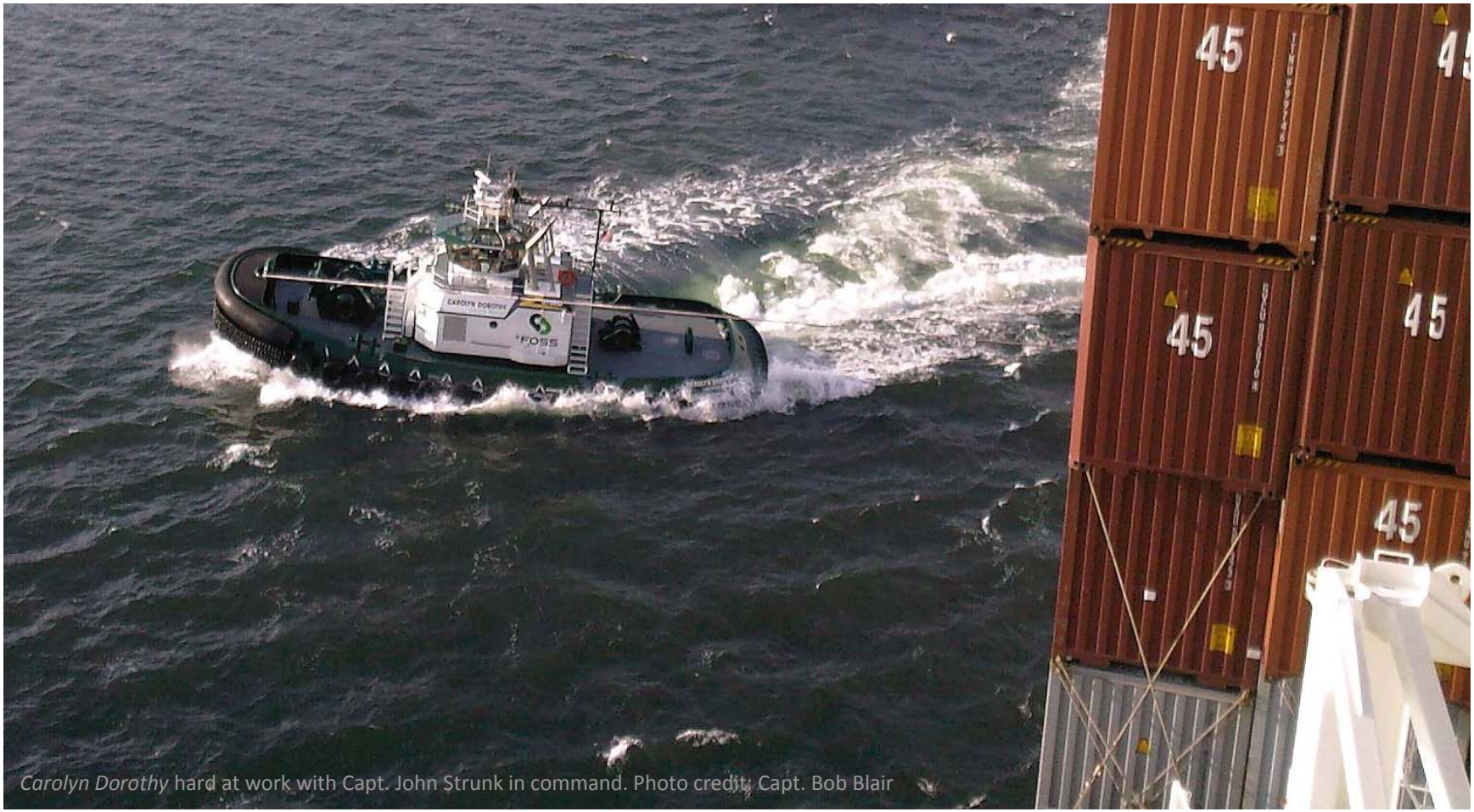
Foss Maritime – Going Green!

- Certified 14001 Environmental Management System for all vessels and offices
- ISO 9001, ISM, Responsible Carrier Program(RCP).
- Voluntarily switched their entire fleet to ULSD in 2007
- Full vapor recovery on all petroleum barges, double hulled, LED lighting
- First company accepted into EPA's SmartWay Transport program for their Marine Operations
- Upgrade program for engine purchase using Best Available Control Technologies (Tier 2 and 3 currently)
- Energy audits on 20 vessels
- Shorepower at all docks
- Testing a Diesel Oxidation Catalyst on tug *Brynn Foss*

Recent Environmental Awards & Recognitions

2011	***Chamber of Shipping Environmental Achievement Award*** (also 2010,2009, 2008 and 2007)
2010	***Green Washington 2010 Runner Up*** (Seattle Business)
2010	***Association of Washington Business Environmental Excellence Award***
2009	***WORKBOAT*** Comprehensive Environmental Management Plan (First Place Winner)
2009	***WORKBOAT*** Environmental Initiative Award (Second Place Winner)
2009	***WORKBOAT*** *Carolyn Dorothy* Significant Boats of 2009 winner (more than one winner)
2009	***Significant Small Ships award winner*** - *Carolyn Dorothy* from The Royal Institution of Naval Architects
2009	***Port of Seattle and Propeller Club's*** Marine Environmental Business of the Year
2009	***Port of Long Beach's Green Flag Environmental Achievement Award***
2008	***San Pedro Bay Ports Clean Air Action Plan Clean Air Excellence Award***
2009	***Marine Environmental Business of the Year Honorable Mention*** – Port of Seattle
2008	***Port of Long Beach and Los Angeles Clean Air Action Plan Award***
2008	***Environmental Protection Agency's Clean Air Excellence Award*** – Development of the World's First Low Emissions Hybrid Tug
2008	***U.S. Coast Guard William M. Benkert Award*** for Marine Environmental Protection – Gold Level
2008	***British Petroleum Shipping CEO's HSE Award*** for Outstanding Environmental Achievement
2007	***Environmental Protection Agency's Clean Air Excellence Award*** - Clean Air Technology category

A Green Dolphin !



Carolyn Dorothy hard at work with Capt. John Strunk in command. Photo credit: Capt. Bob Blair

Foss Maritime's Carolyn Dorothy – The World's First Hybrid Tug

Duty Cycle Considerations

The Tug Problem?

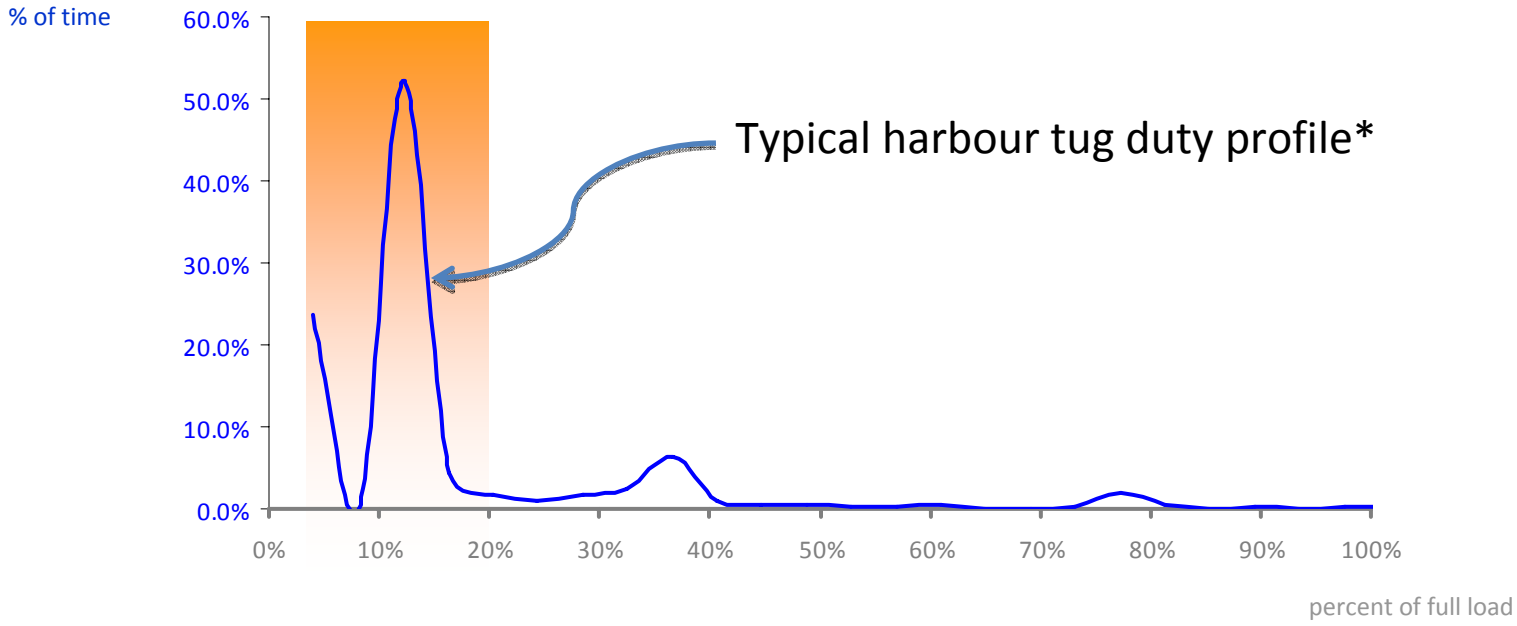
As with other vessel types, tugs need lots of power….but not very often.

They are designed for full out…but typically run there less than 3% of the time….otherwise… they are near idle.

In fact…they usually operate in the least efficient part of their range.

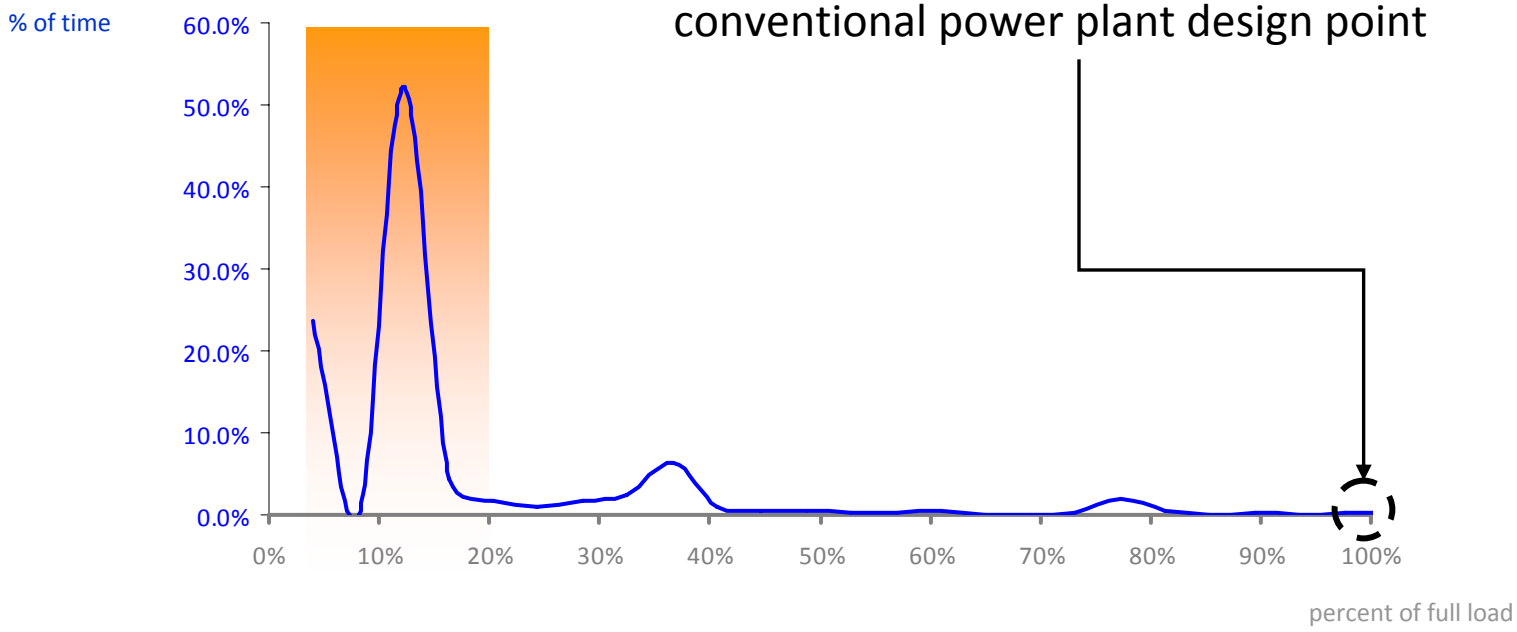
Specific fuel consumption “rears its ugly head”.

The Hybrid Tug Rationale

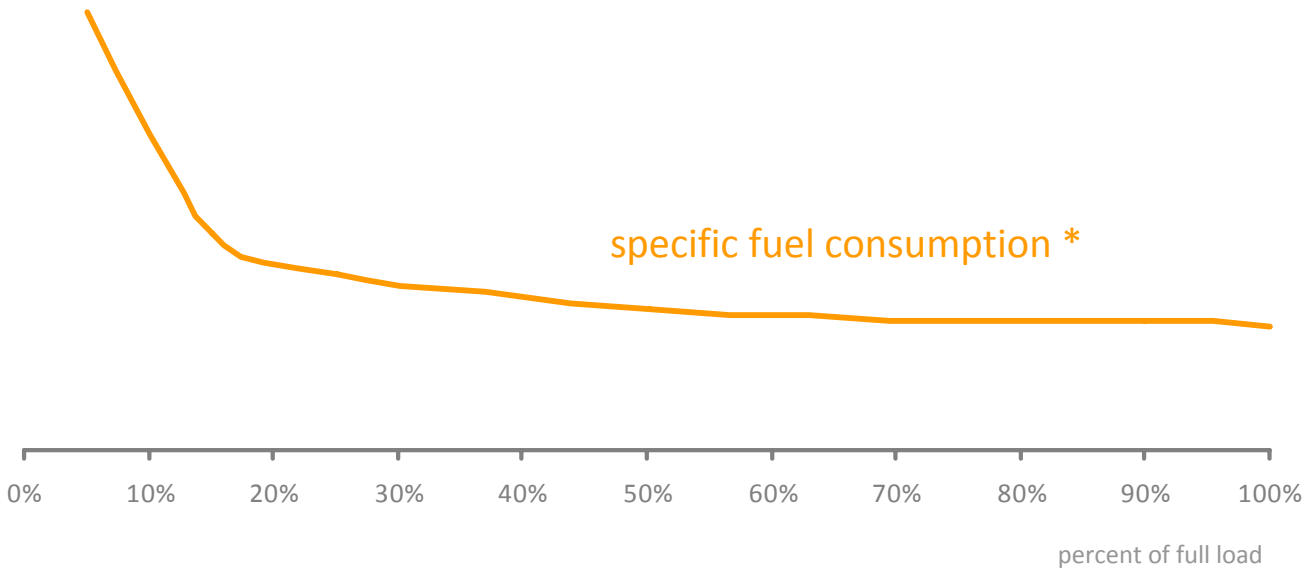


*data from actual operations, Foss Maritime SoCal

The Hybrid Tug Rationale



The Hybrid Tug Rationale



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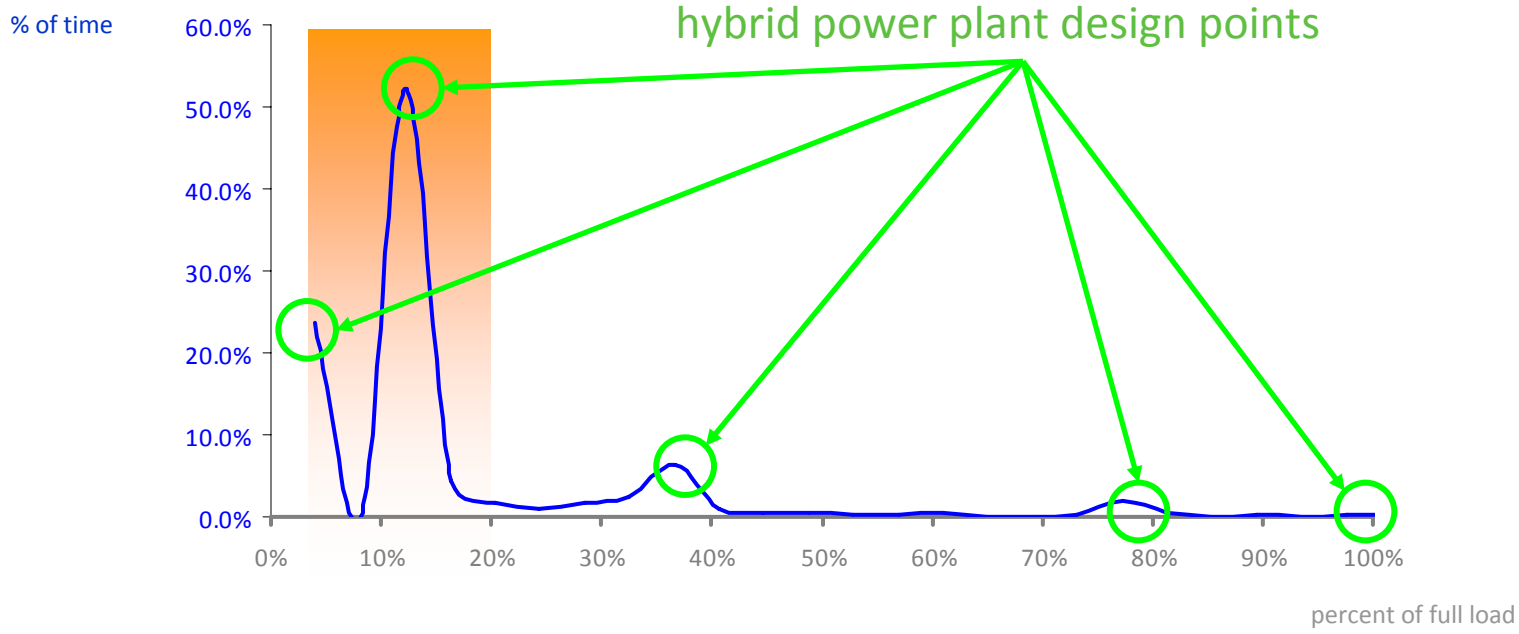
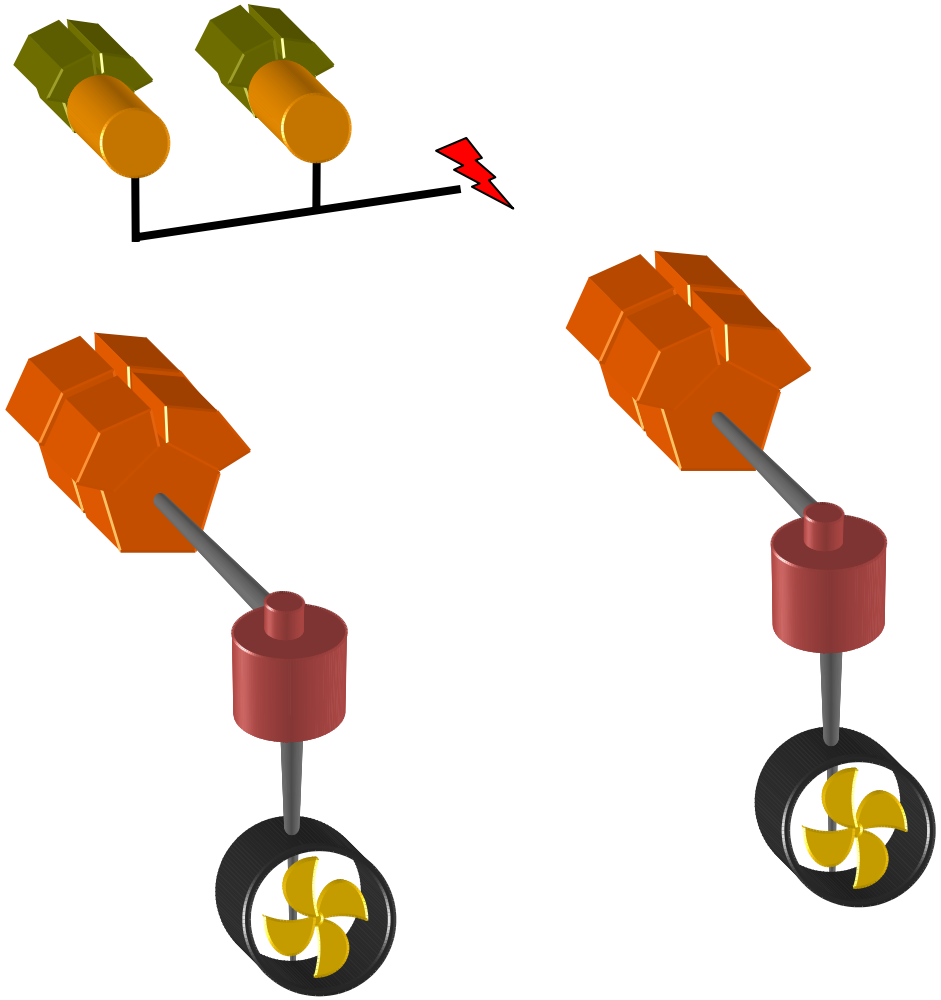
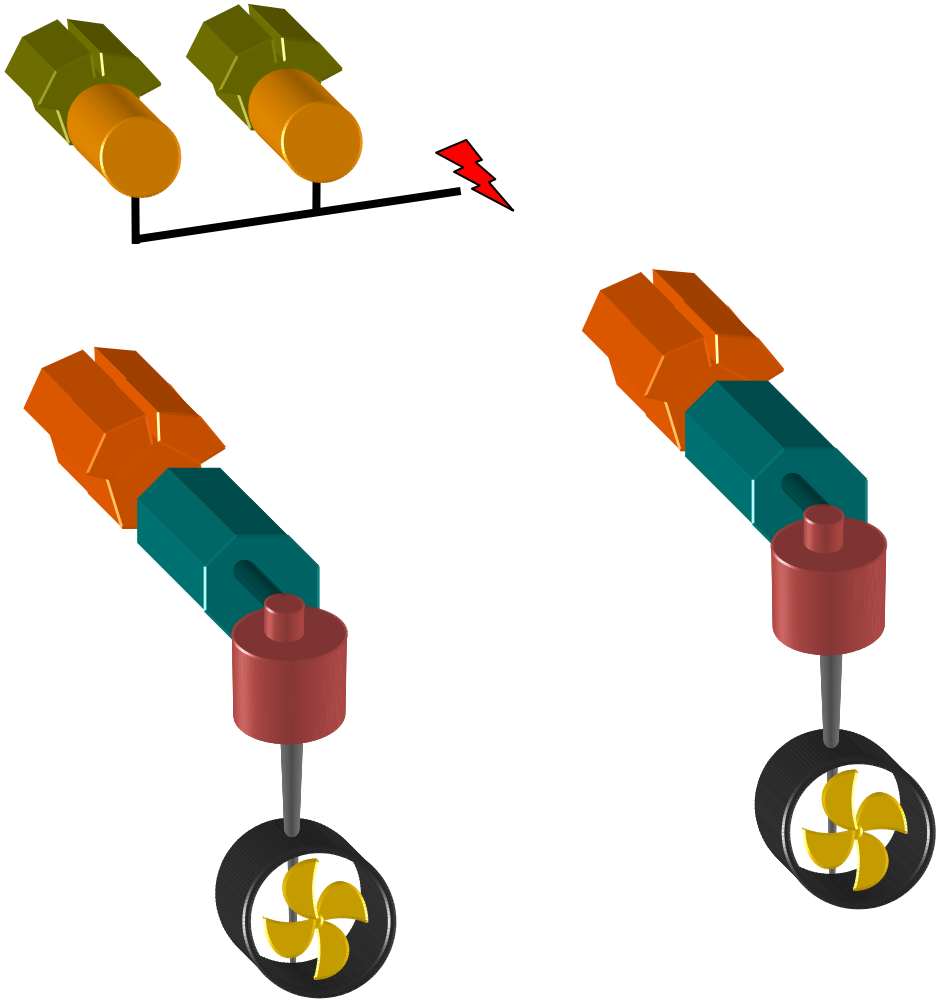


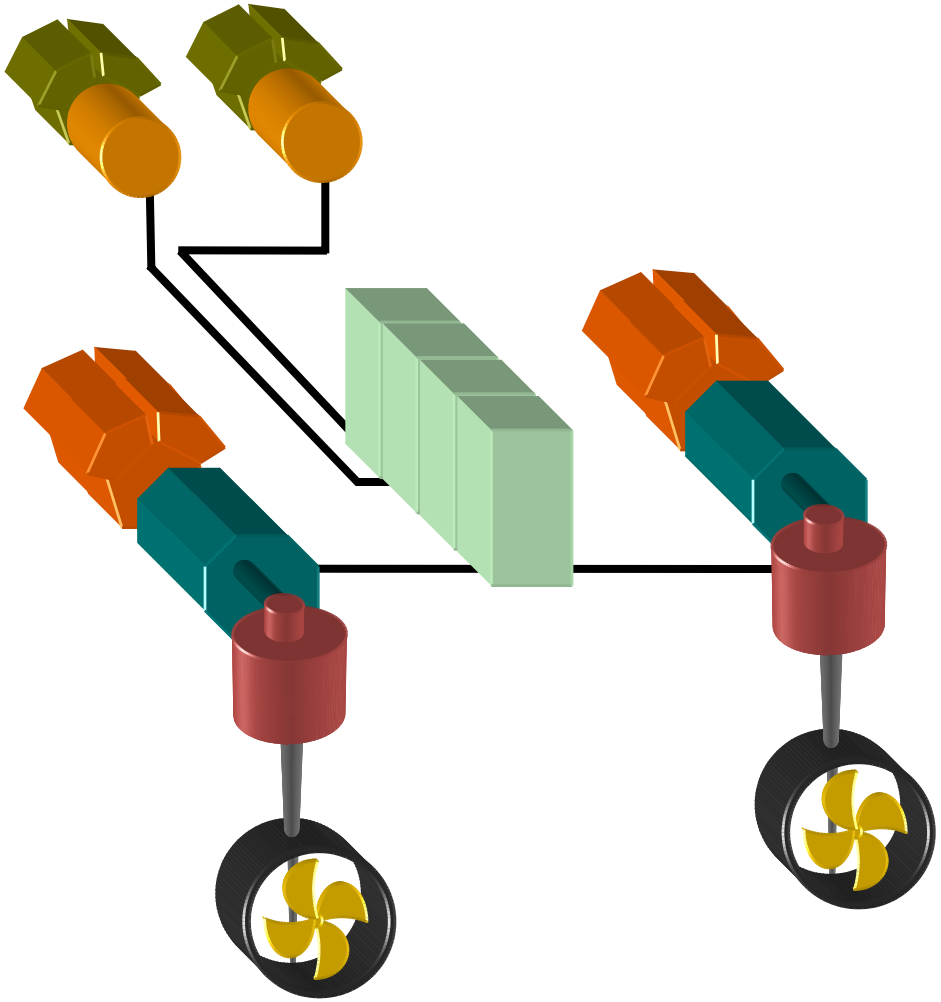
Definition & Schematic Diagrams

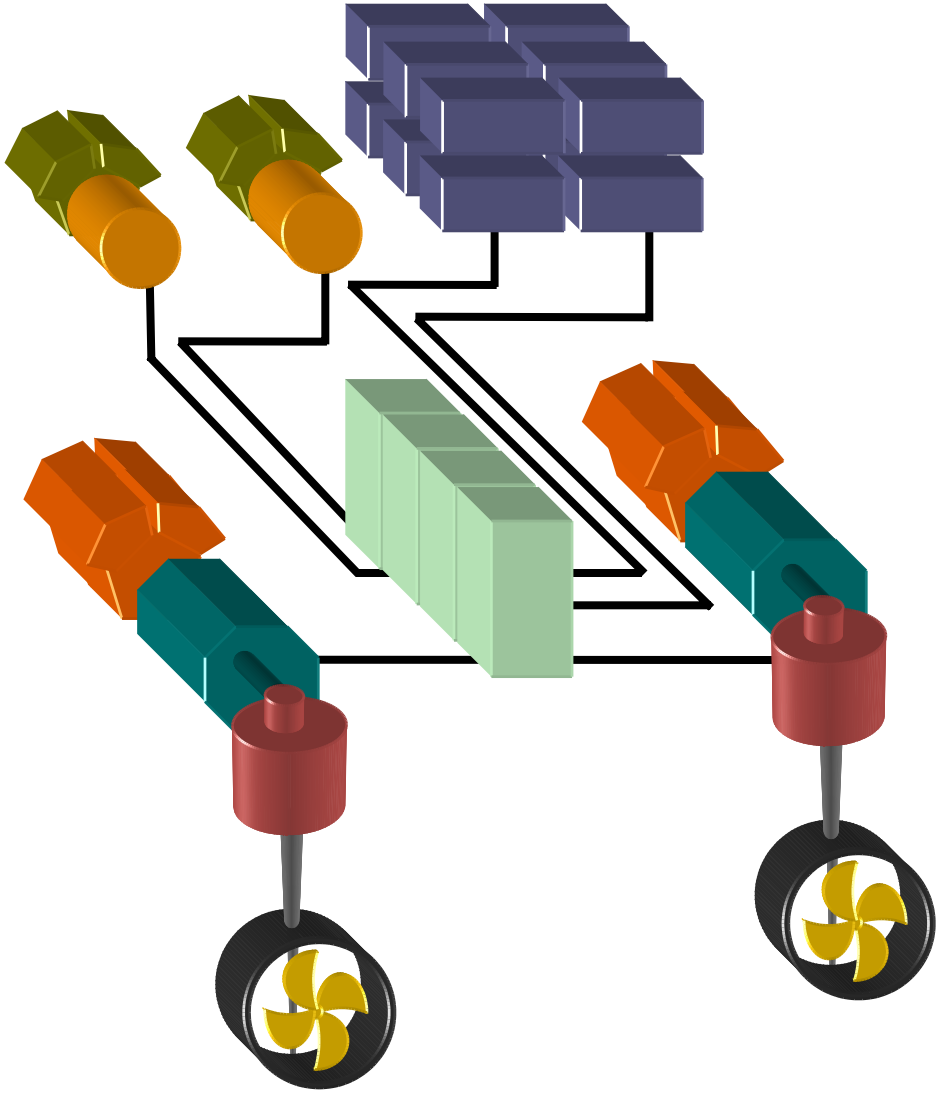
xero point hybrid

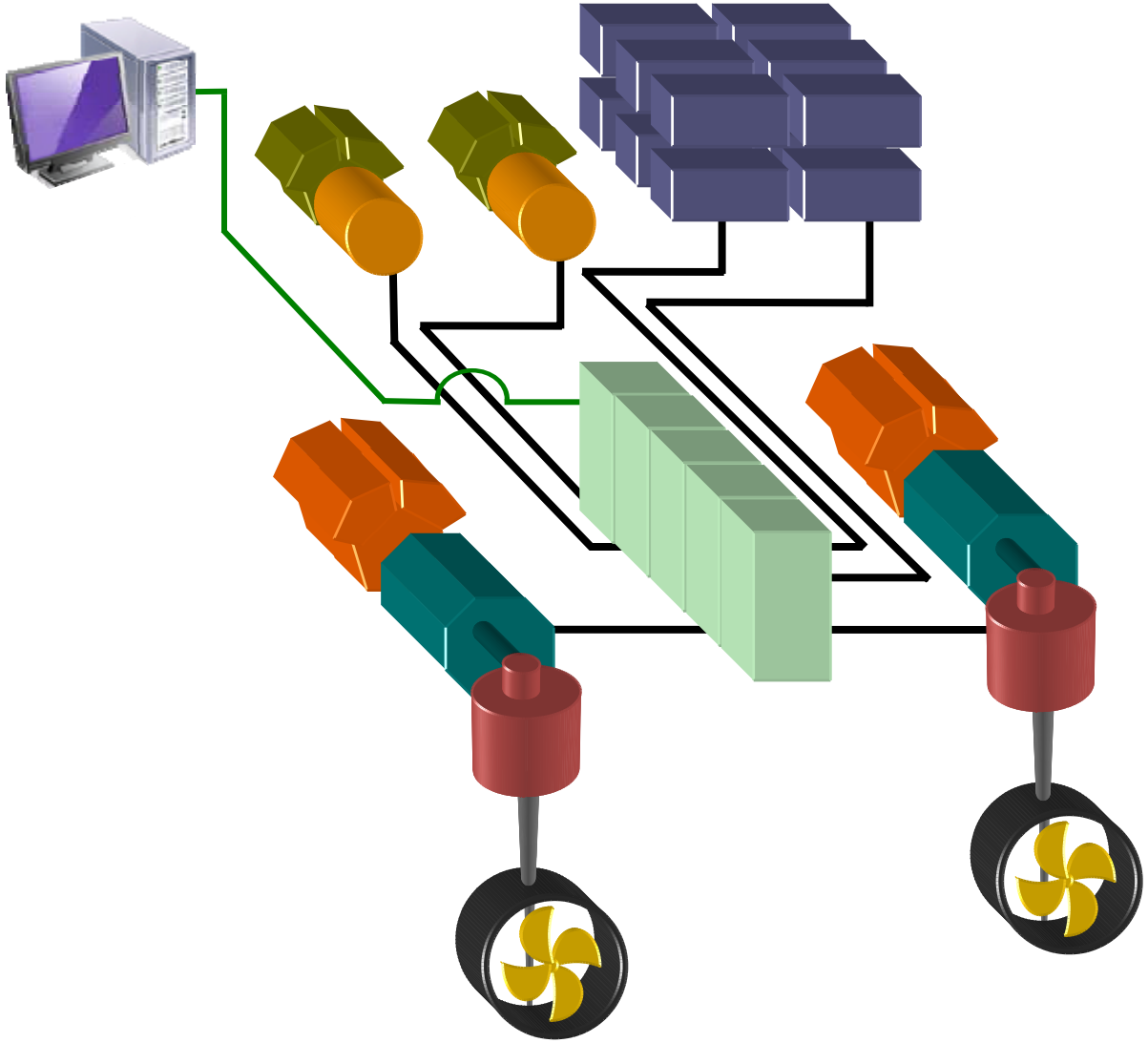
A propulsion system which incorporates a combination of drive line configurations, an energy management system, and/or energy storage to reduce or eliminate the low efficiency operation of diesel engines.



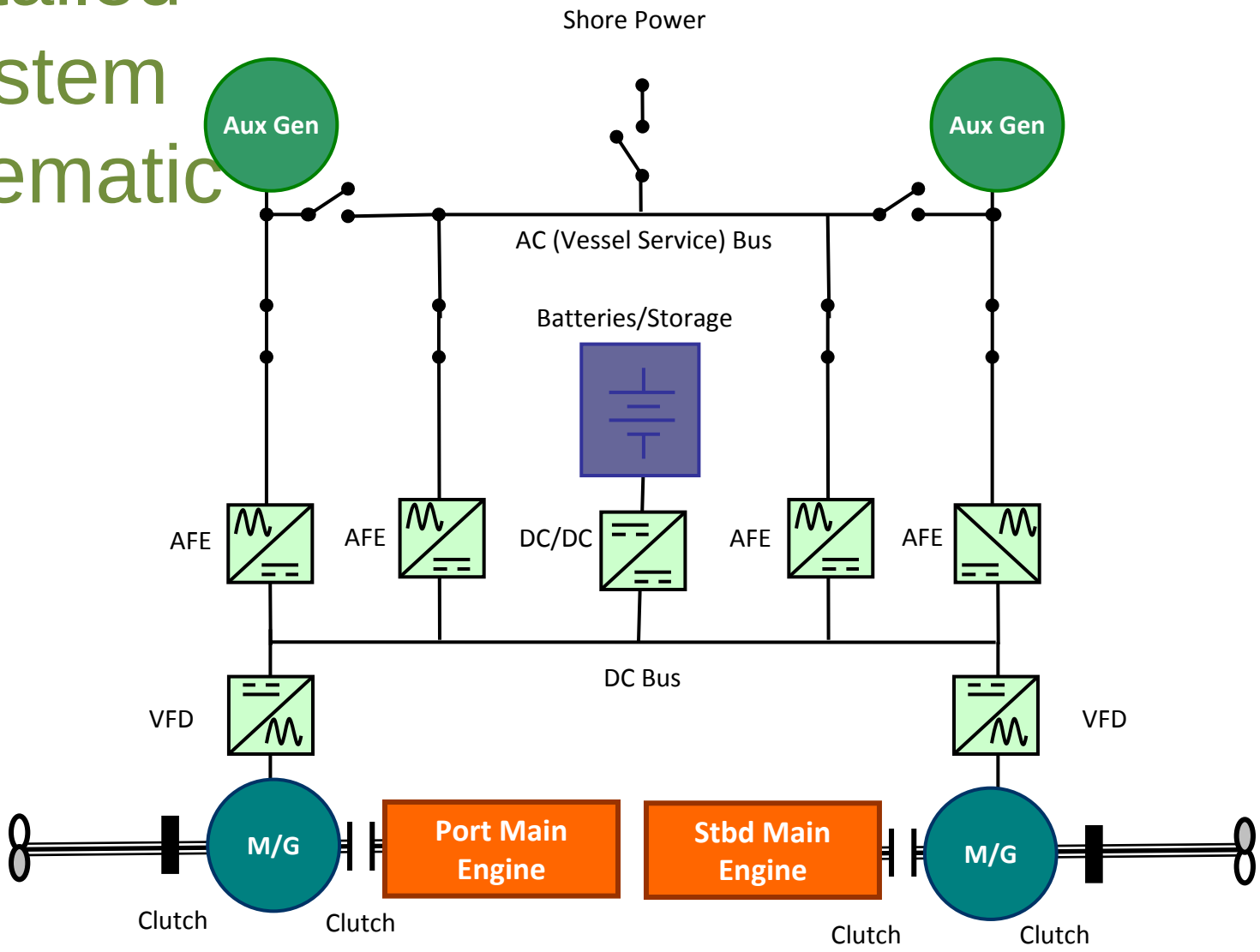






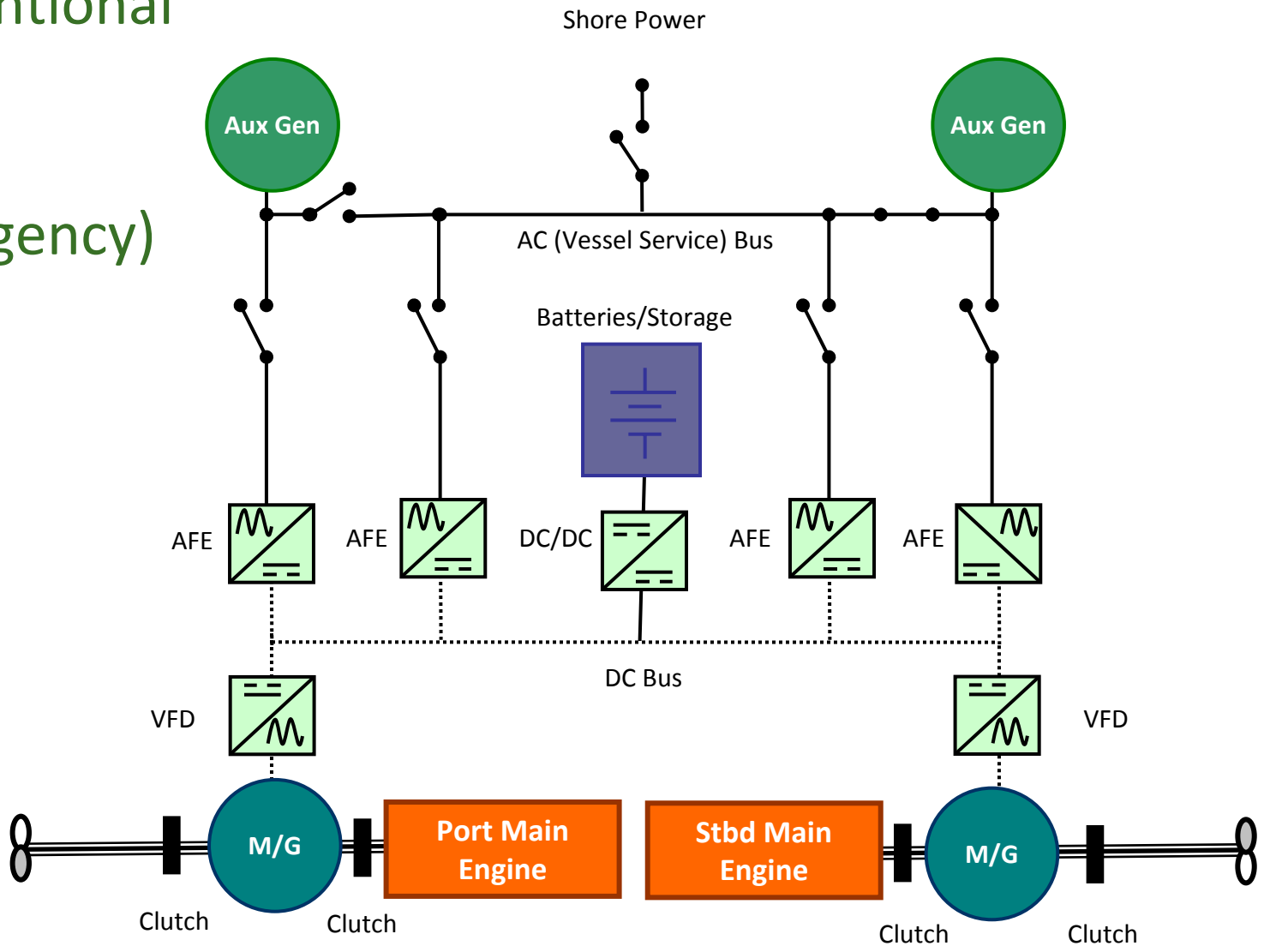


Detailed System Schematic



Conventional Mode

(Emergency)



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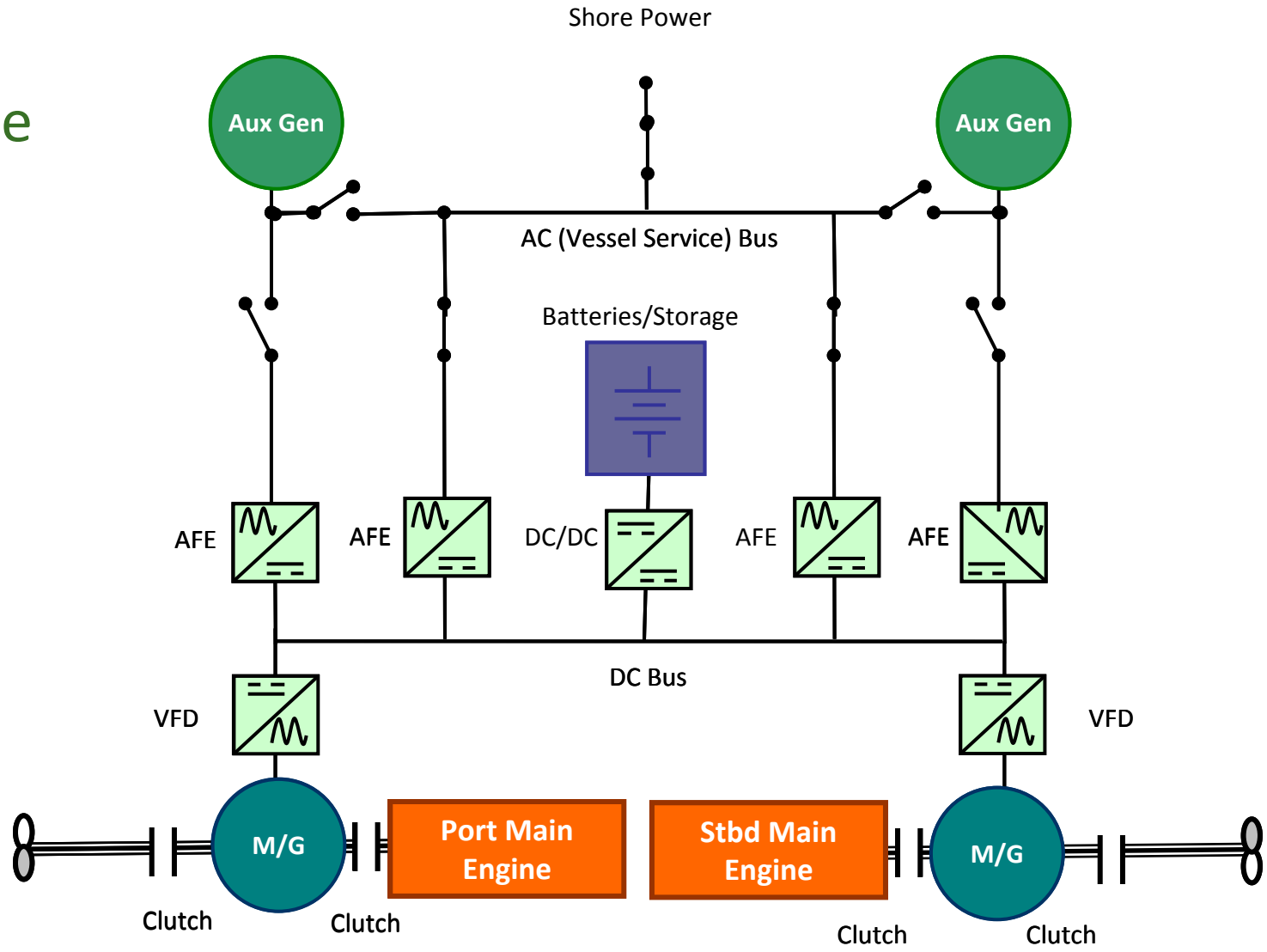
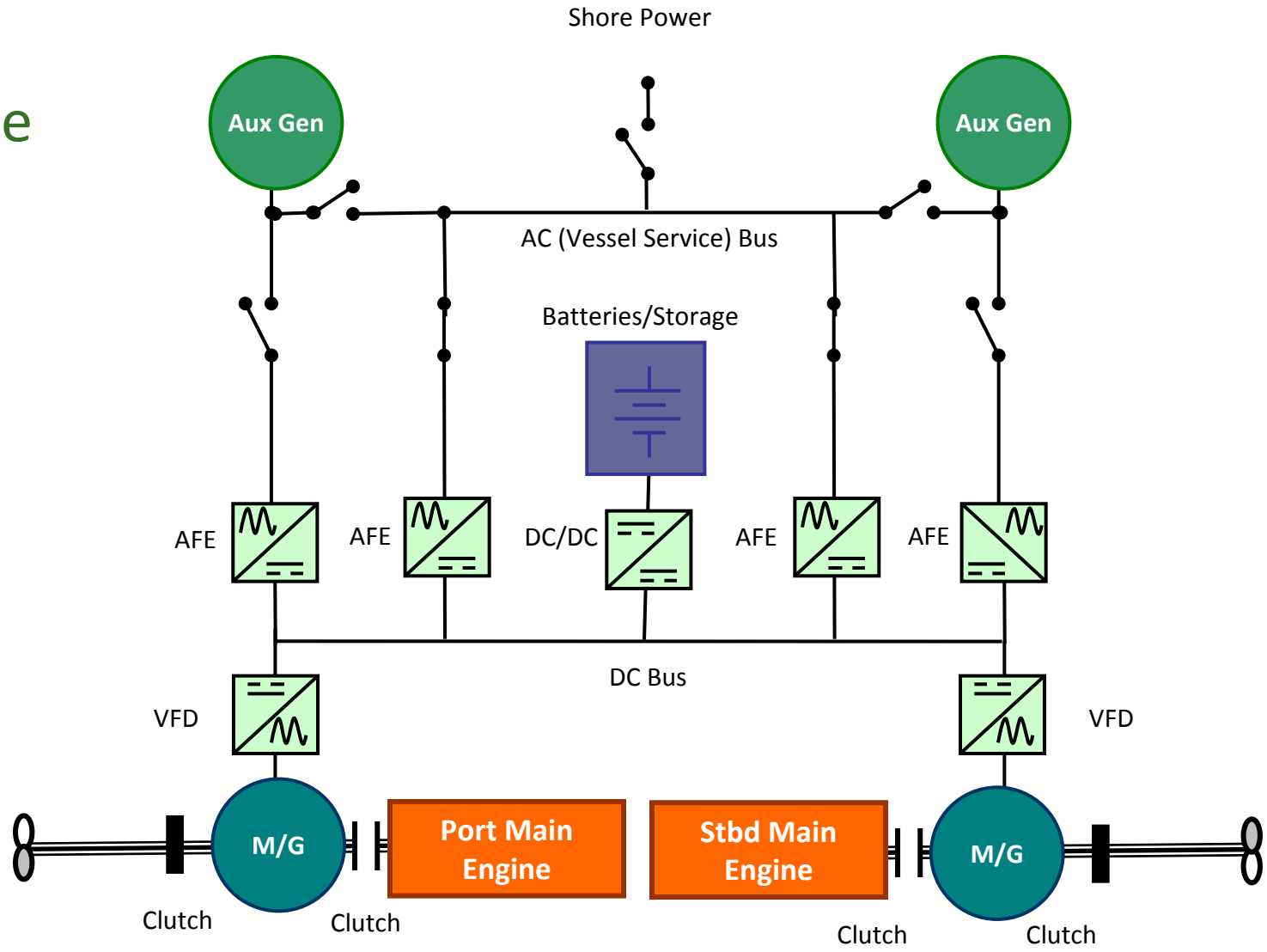
Stop Mode


Shore Power
Aux Gen
Aux Gen
AC (Vessel Service) Bus
Batteries/Storage
AFE
AFE
DC/DC
AFE
AFE
DC Bus
VFD
VFD
M/G
Port Main Engine
Stbd Main Engine
M/G
Clutch
Clutch
Clutch
Clutch

Idle Mode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VFD
M/G
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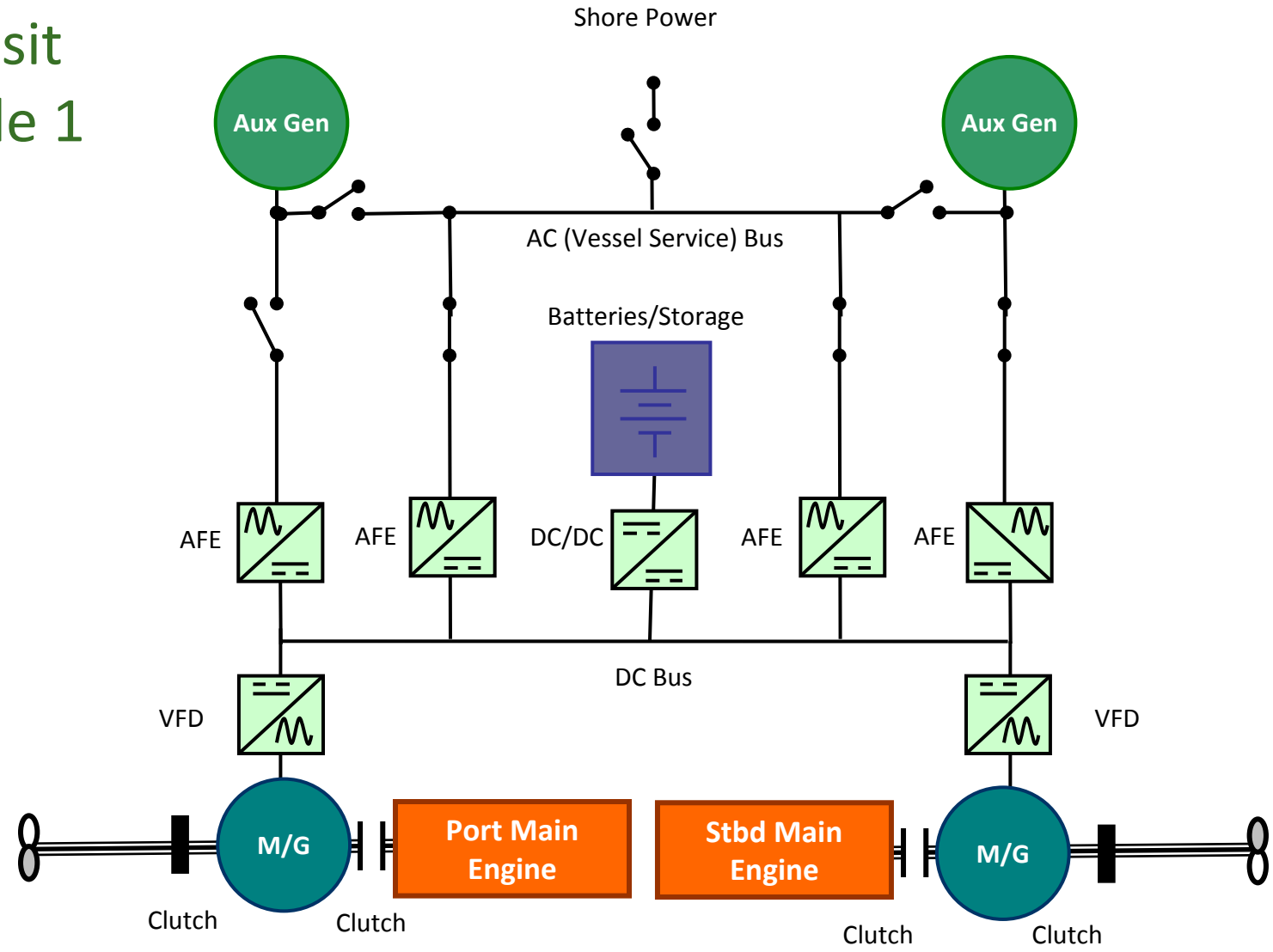
Stbd Main Engine
M/G
Clutch
Clutch
Clutch
Clutch

Transit Mode 1



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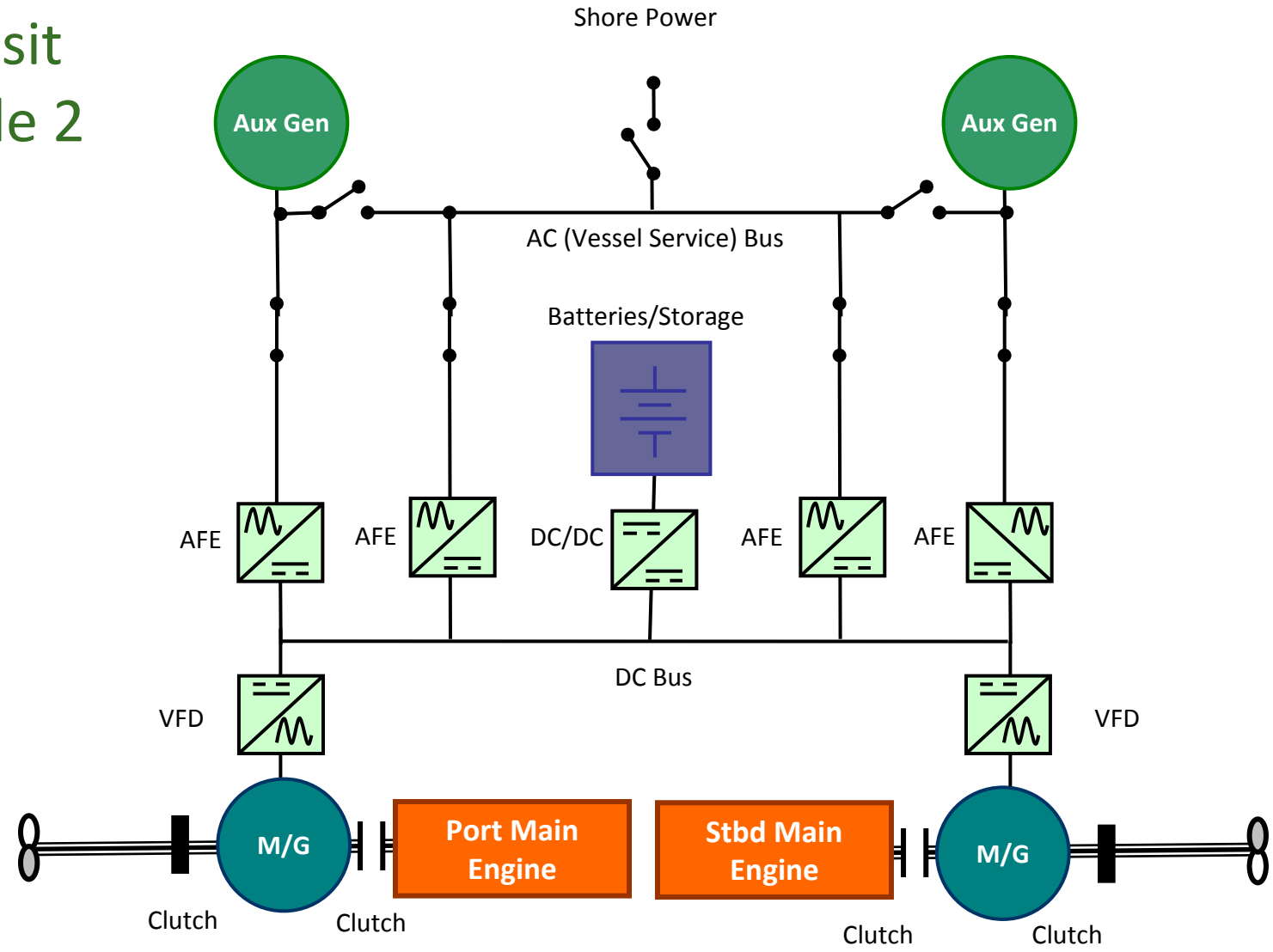
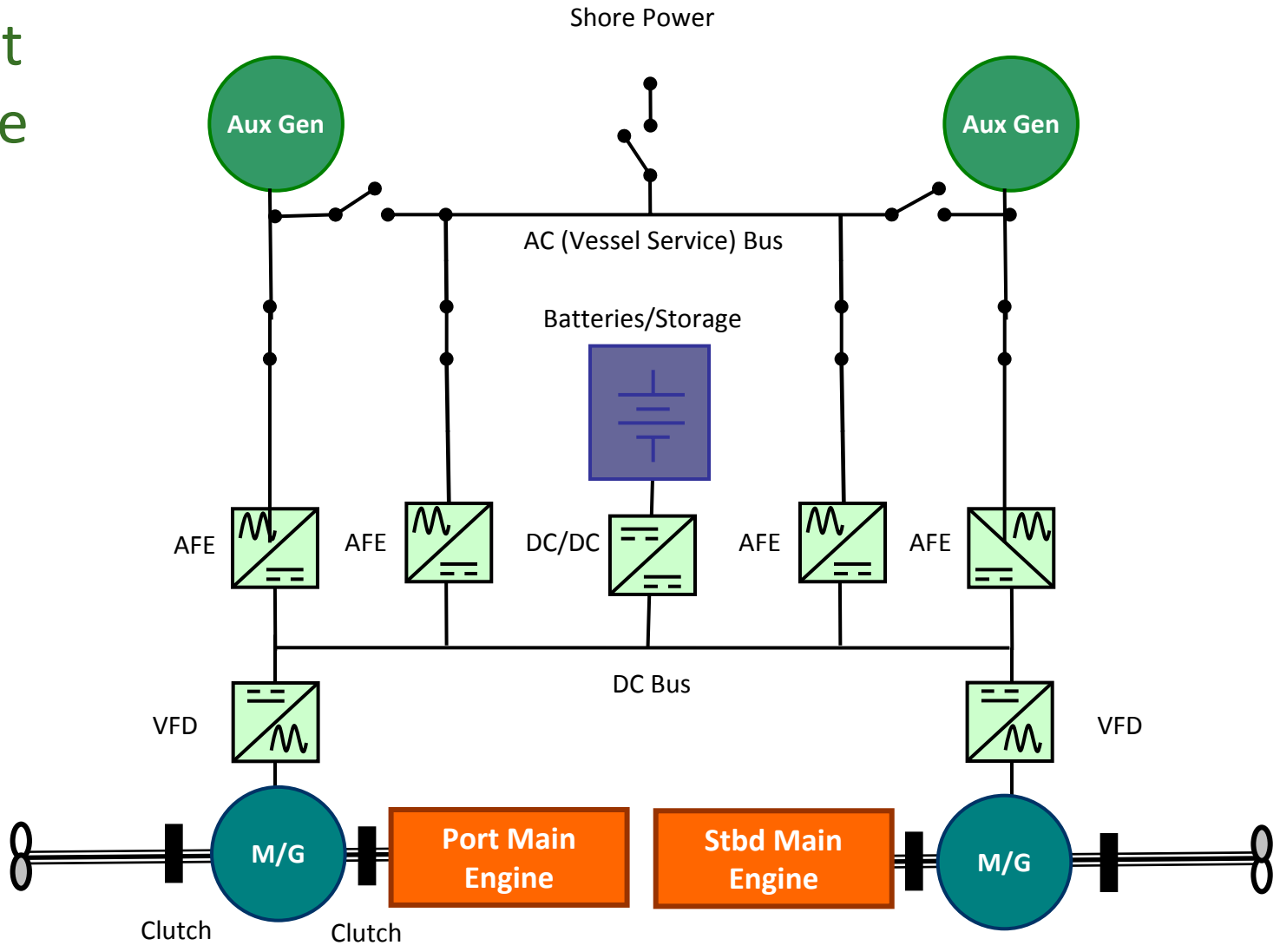
Transit Mode 2



Assist Mode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AC (Vessel Service) Bus
Batteries/Storage
AFE
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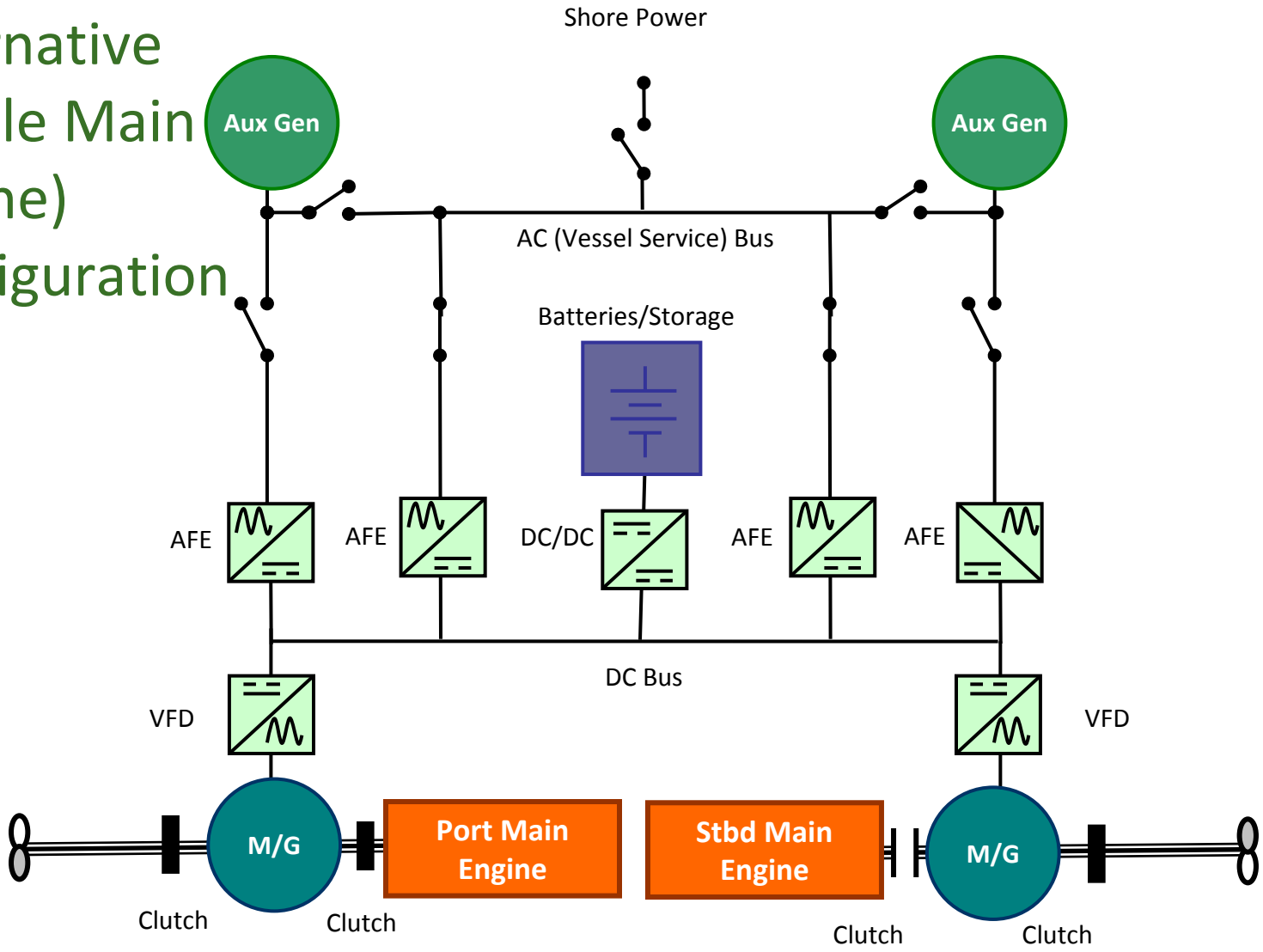
VFD
VFD
M/G
Port Main Engine
Stbd Main Engine
M/G
Clutch
Clutch

Alternative (Single Main Engine) Configuration



Construction


SIEMENS

The Hybrid Vessel


HYBRID
CAROLYN DOROTHY
GREEN ASSIST
FOSS

Engine Room

Engine Room

New Hybrid Projects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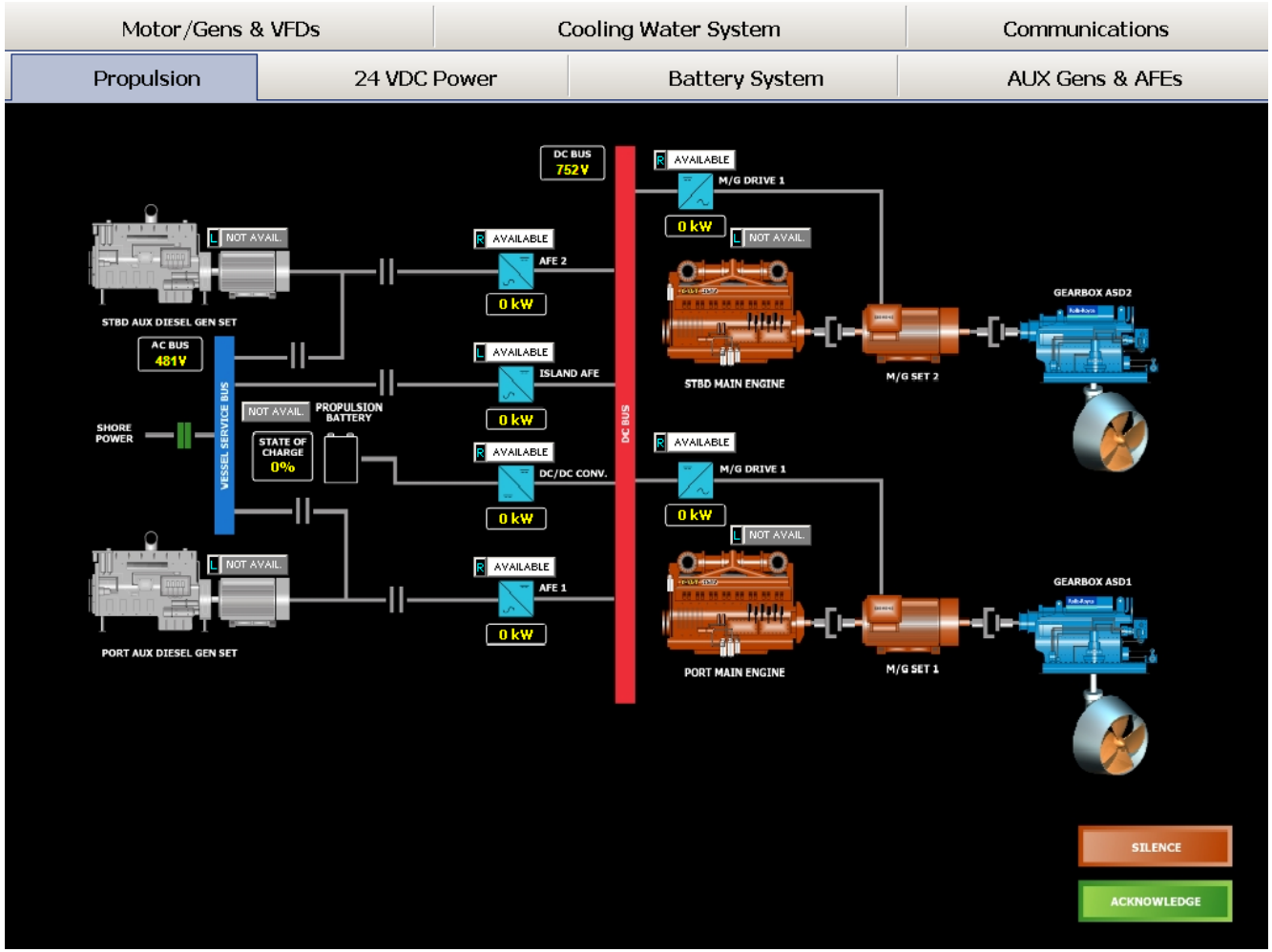
Hybrid Cabinets

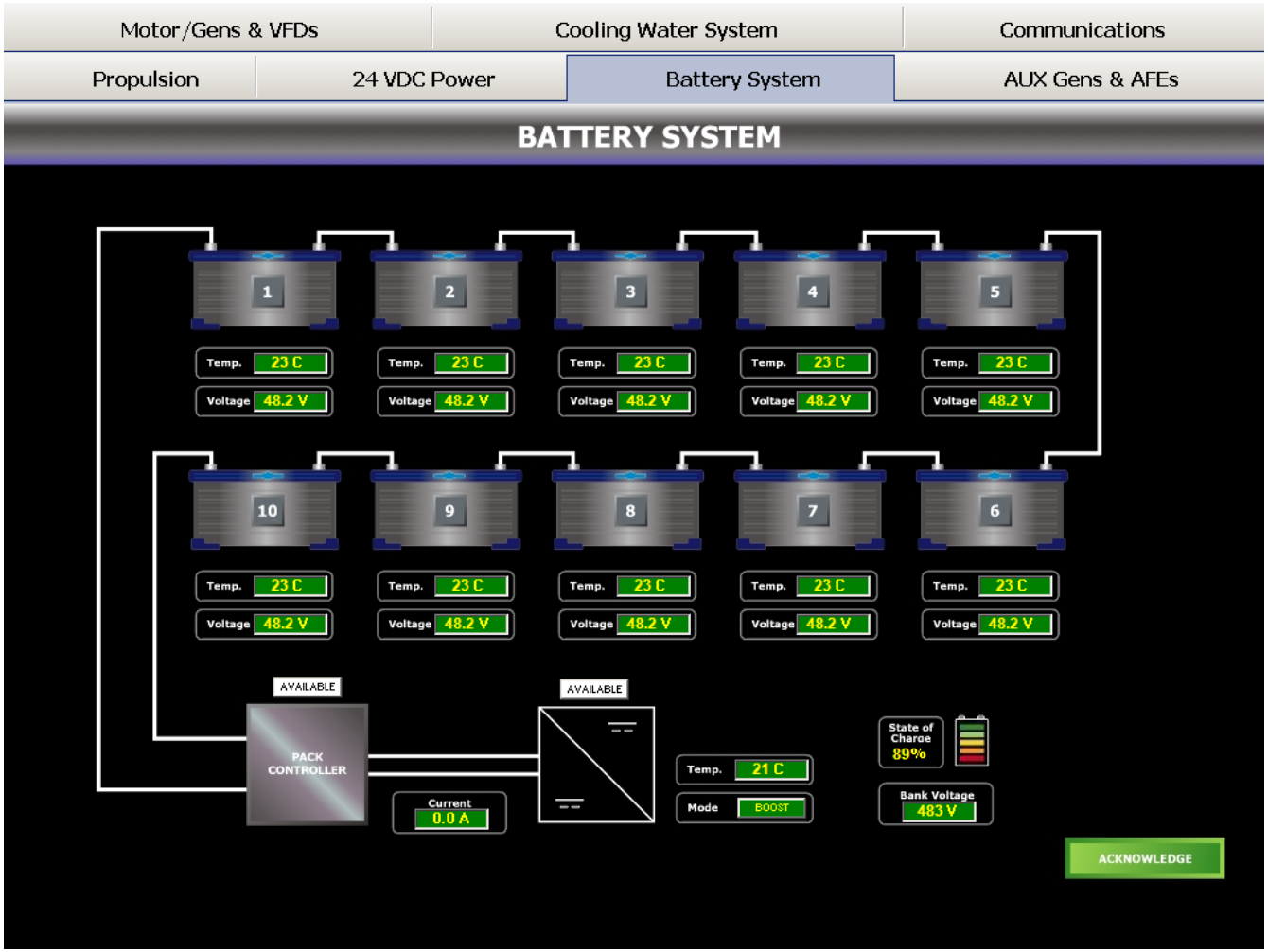
Build Photos

Build Photos

Human Machine Interface

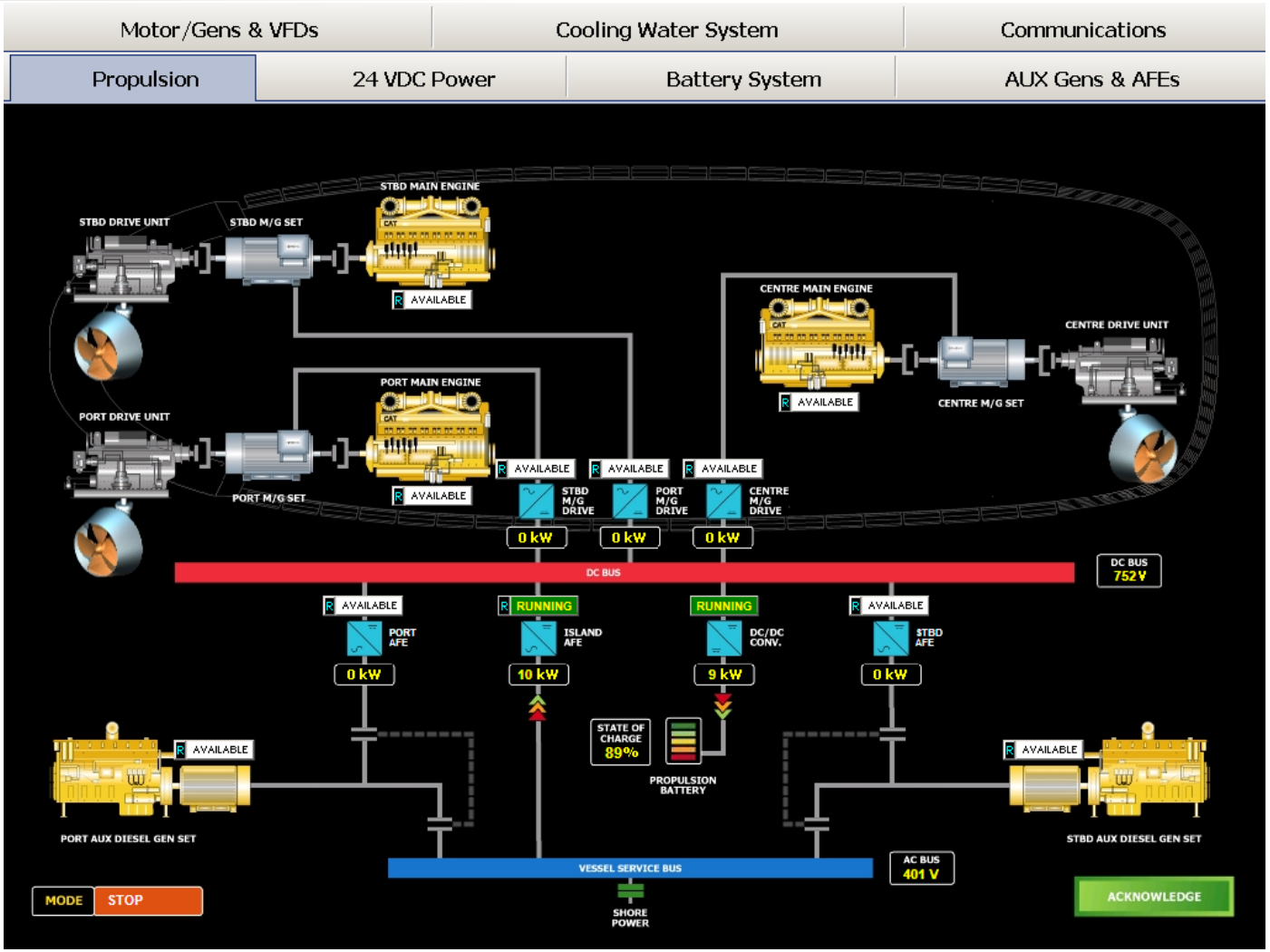


Human Machine Interface

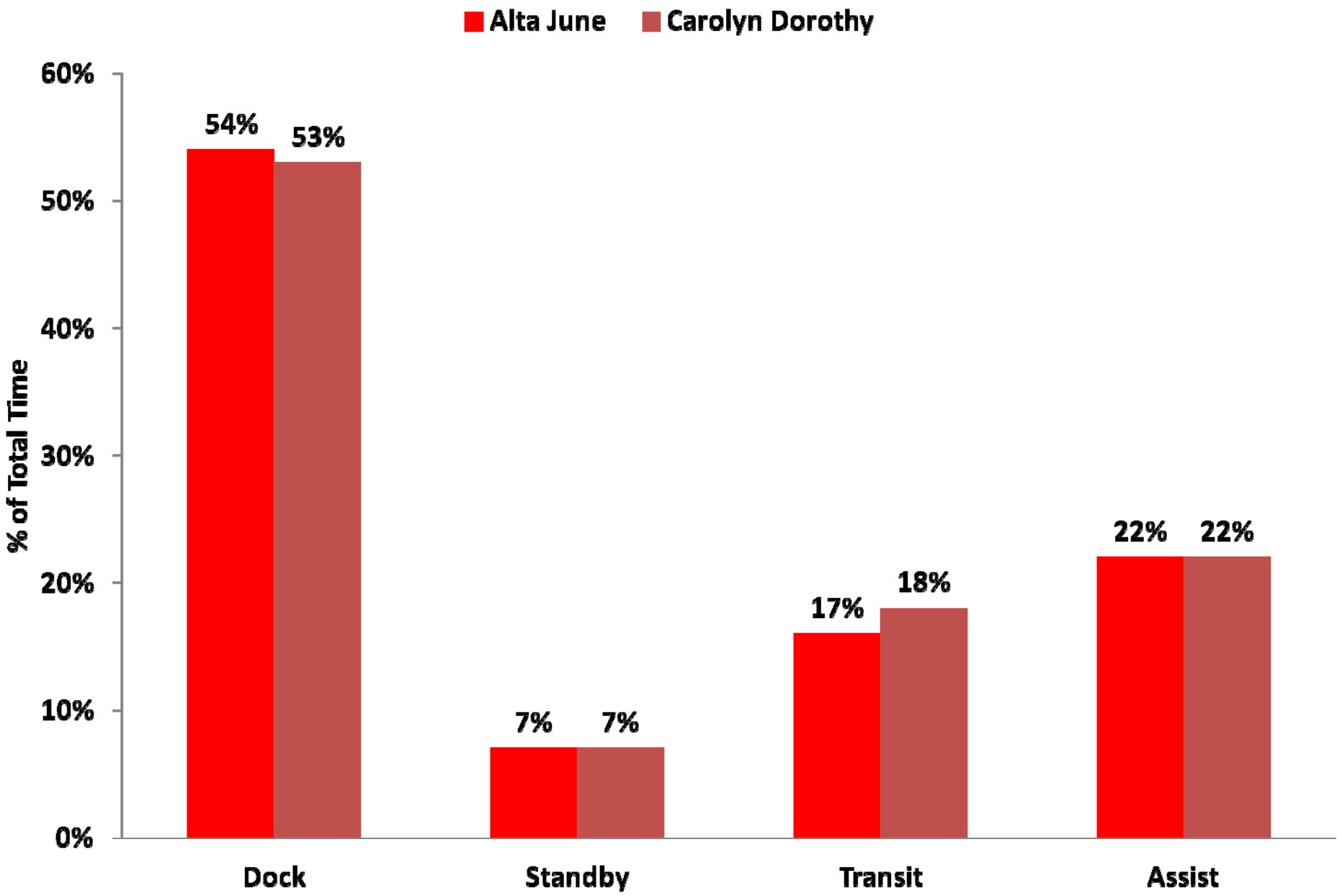


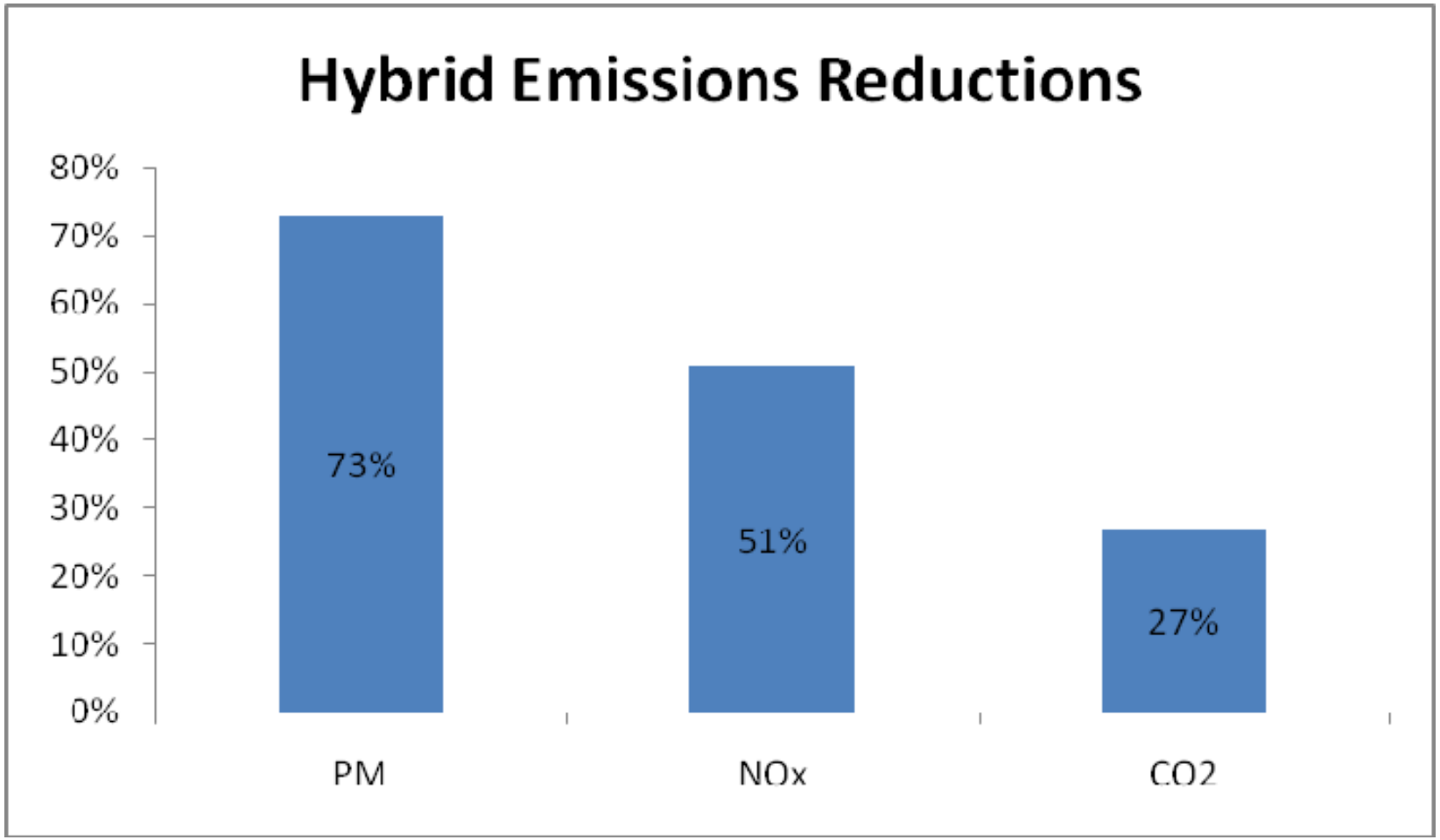

RT ADRIAAN

Human Machine Interface



Hybrid Cabinets


Alta June
Carolyn Dorothy
60%
50%
40%
30%
20%
10%
0%
% of Total Time
54%
53%
7%
7%
17%
18%
22%
22%
Dock
Standby
Transit
Assist



SOURCE: **California Air Resource Board Report**
Prepared by: **University of California – Riverside**
College of Engineering-Center for Environmental Research and Technology

Questions?