built on trust™

VARD™

a Fincantieri company

UBC-IEEE MARINE SYSTEMS WORKSHOP

MARCH 15, 2019

Introduction

- Robert Louie, P.Eng, PE
- Managing Director

- Dan McGreer, P.Eng
- Principal Naval Architect

9 Shipyards worldwide

Norway Vard Aukra, Vard Brattvaag, Vard Brevik, Vard Langsten, Vard Søviknes

Brazil Vard Promar

Romania Vard Braila, Vard Tulcea

Vietnam Vard Vung Tau

VARD is present in Norway, Romania, Vietnam, Brazil, Croatia, Italy, Poland, Canada, US, India, Chile and Singapore with various entities supporting the shipbuilding process.

Shipbuilding and Marine Industry

- Ships are transport and platform vessels that are complex to design and build
- Requires multi-discipline engineering knowledge to create innovative solutions and overcome design/build challenges
- Unique challenges that require close collaboration between our different disciplines of engineering
- With the current shipbuilding industry there is a need for electrical engineers with knowledge in marine applications
- Knowledge of regulatory framework

Shipbuilding and Marine Industry

- The Canada Government is renewing its fleet
- Wants to re-establish the shipbuilding industry
- Embarked on a NSS program in 2010
- Need to rebuild the lost shipbuilding talent
- IRB/ITB requires Canadian engineers
- Need to grow expertise

National Shipbuilding Strategy

Combat Ship Contract
Irving Shipbuilding
Halifax Shipyard

Arctic Offshore Patrol Ship (AOPS)

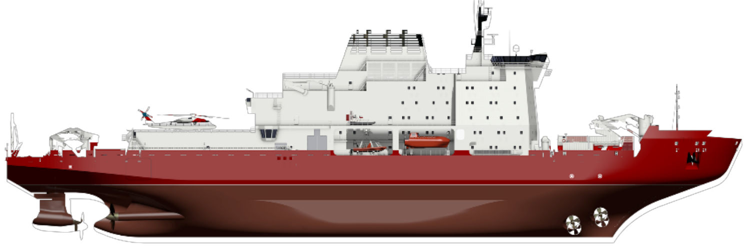
Canadian Surface Combatant (CSC)

Non-Combat Ship Contract
Seaspan
Vancouver Shipyard

Offshore Fisheries Science Vessel (OFSV)

Offshore Oceanographic Science Vessel (OOSV)

Joint Support Ship (JSS)



Polar Icebreaker (PIB)

AROUND THE WORLD

NEW ZEALAND

BRAZIL

CHILE

CHINA

UNITED KINGDOM

CANADA

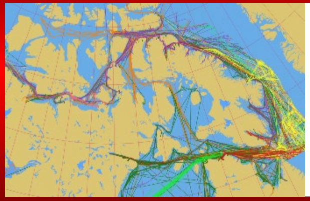
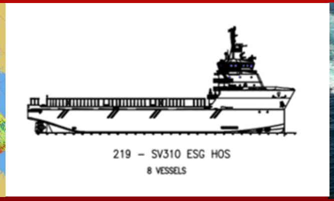
INDONESIA

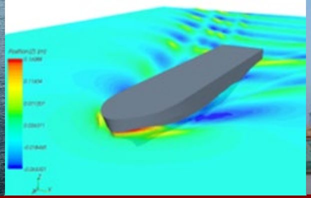
NORWAY

United States

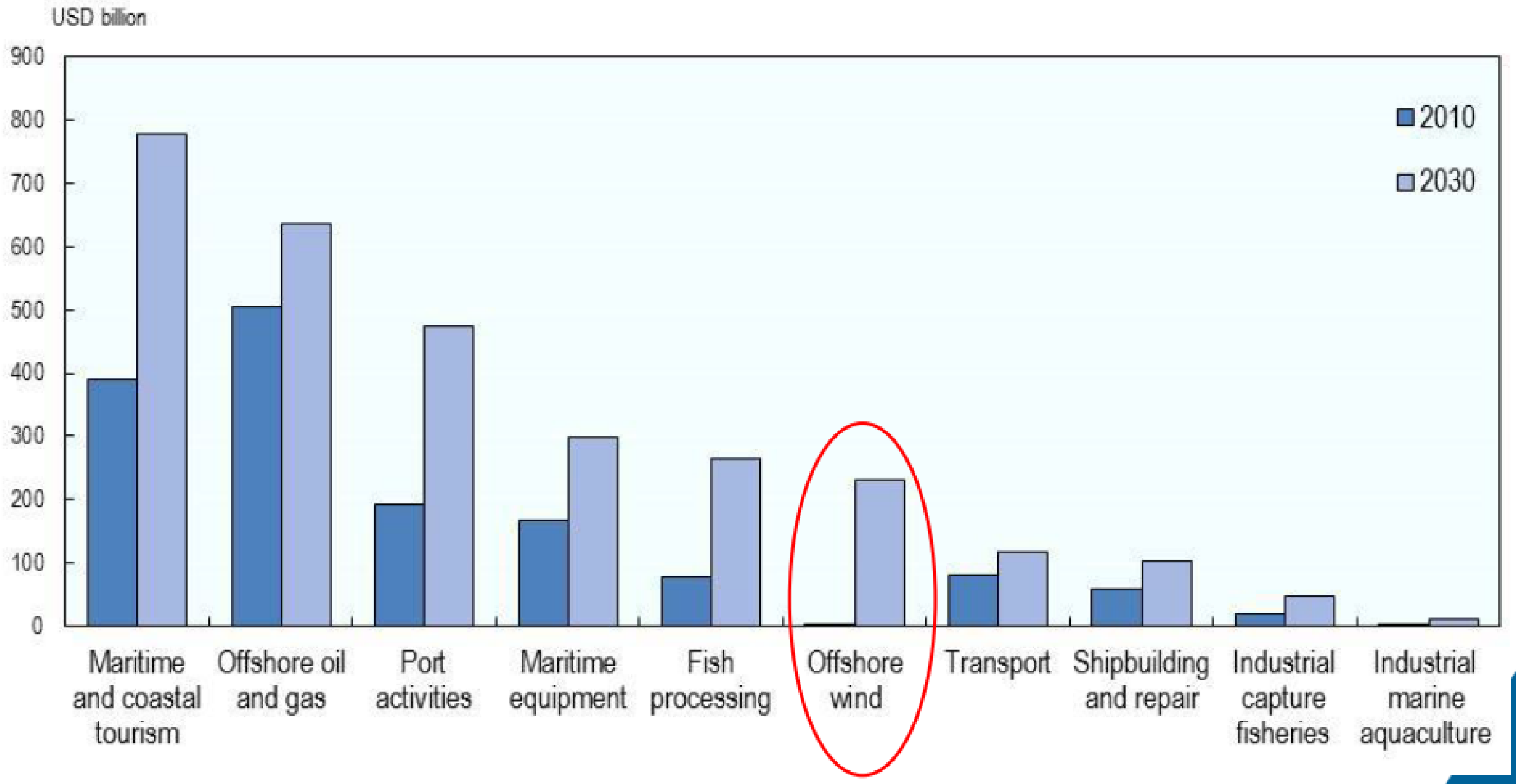
SHIP AND MARINE STRUCTURE DESIGN

Concept Development	Engineering Analysis	Shipyard Support
Basic Naval Architecture	Naval Architecture	Functional Design Package
Feasibility Studies	Structural Designs	Construction Specifications
Cost Estimates	Machinery Arrangements	Production and Build Support
Vessel Specification	Electrical System Design	On-site Supervision
Propulsion Trade-off Studies	Automation Design	Trials Supervision
HAZID / HAZOP Analysis	Integrated Bridge Systems	Equipment Procurement
Condition Analysis	Equipment Selection	
	Marine Systems Design	
	Outfit Drawings	
	Environmental Applications	

Ocean-based industries' value-added to double (from USD 1.5 to 3 trillion) by 2030



Source: OECD (2016), *The Ocean Economy in 2030*, OECD Publishing.

Challenges for the Shipbuilding & Marine Sector

Science, technology and innovation in tomorrow's ocean economy: some drivers

- Enhancing competitiveness via efficiency gains/cost-saving *(e.g. autonomous ships)*
- Expanding technological frontiers *(e.g. complex subsea engineering)*
- Responding to climate change and sustainability challenges *(e.g. biotechnology, traceability, green technologies)*
- Improving knowledge of the ocean environment, bio-diversity and marine ecosystems *(e.g. new sensors, sea-floor mapping, satellites)*

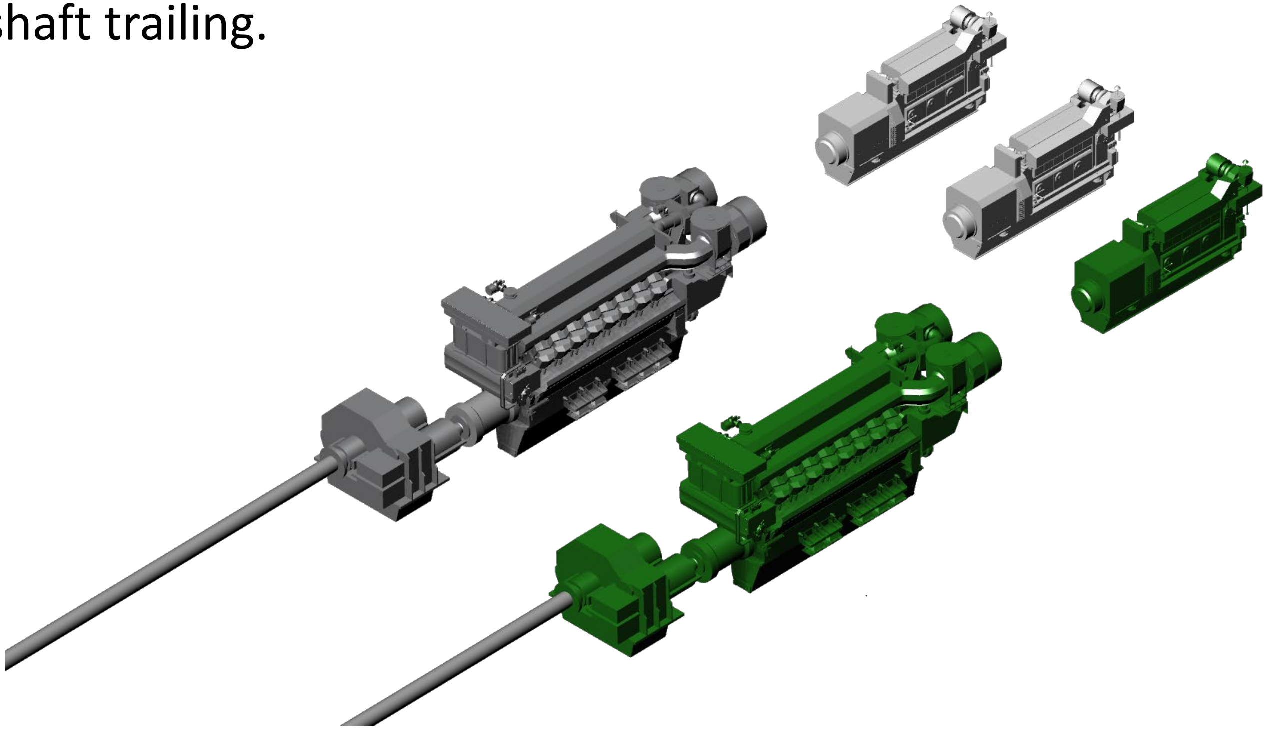
Key role of science, technology and innovation in the future of the ocean economy with important policy implications

Propulsion Options – Case Study VARD 7 095

Principal particulars	
Length	95.0 m
Breadth	14.0 m
Depth	7.1 m
Design draft	4.0 m
Speed	24 knots
Range	7000 nm
Installed Power per shaft	7000 kW

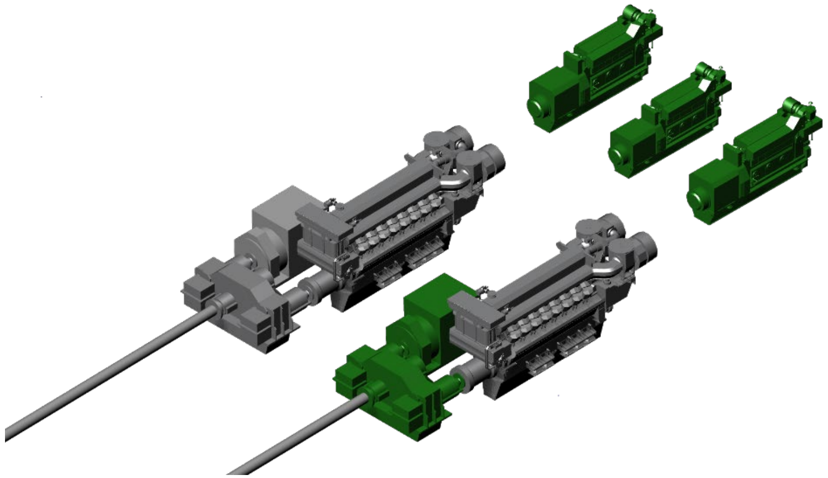
Propulsion Options for OPVs

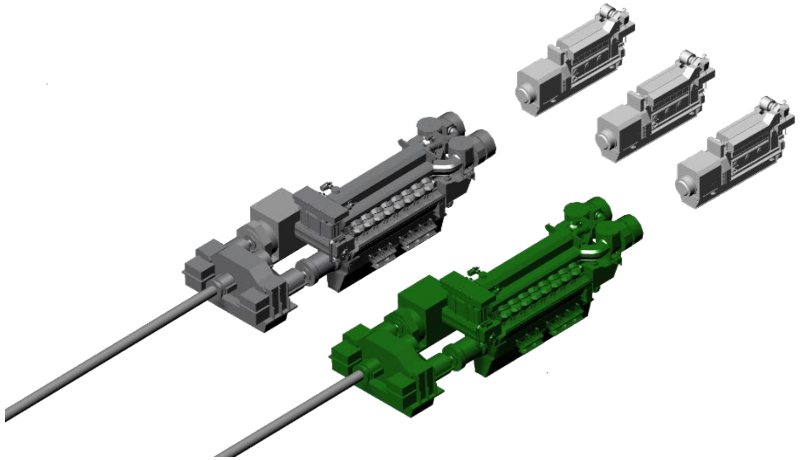
- Traditionally OPVs have twin screw propulsion systems with a reduction gear and one powerful diesel on each shaft.
- This configuration is reliable, robust and cost effective but is not efficient at slow speeds.
- At cruising speeds OPVs are typically operated on one shaft with the other shaft trailing.



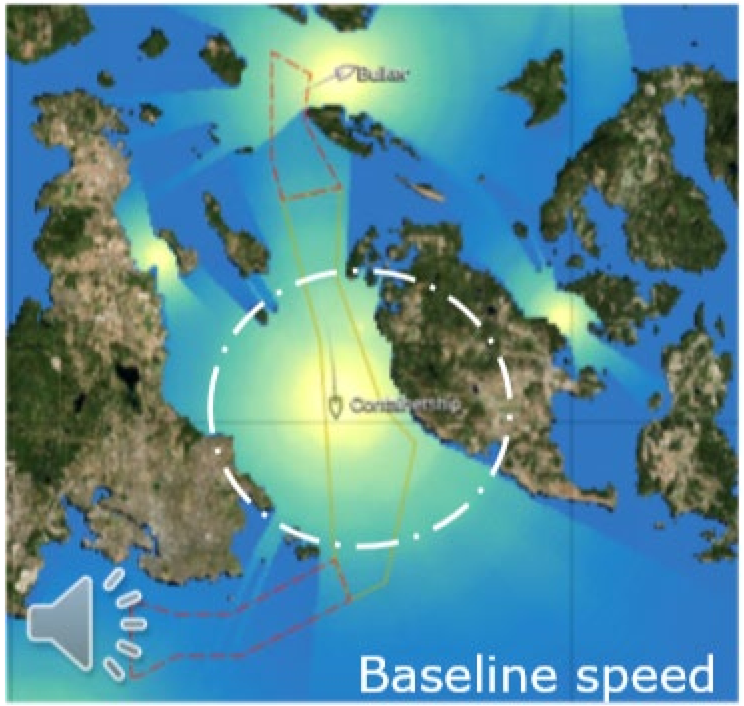
Hybrid Propulsion Options for OPVs

- Addition of a electric motor/generator on each shaft greatly increases the flexibility of the propulsion plant.
- At slow speeds the main diesels are shutdown and the ship is propelled by the electric motors (PTI) from the auxiliary generators. The generators are more optimally loaded, therefore, they have better fuel efficiency.
- The motor can also be used as a generator (PTO) at higher power levels enabling more efficient fuel consumption with the main engines.





Electric Propulsion – Reducing Ship Noise

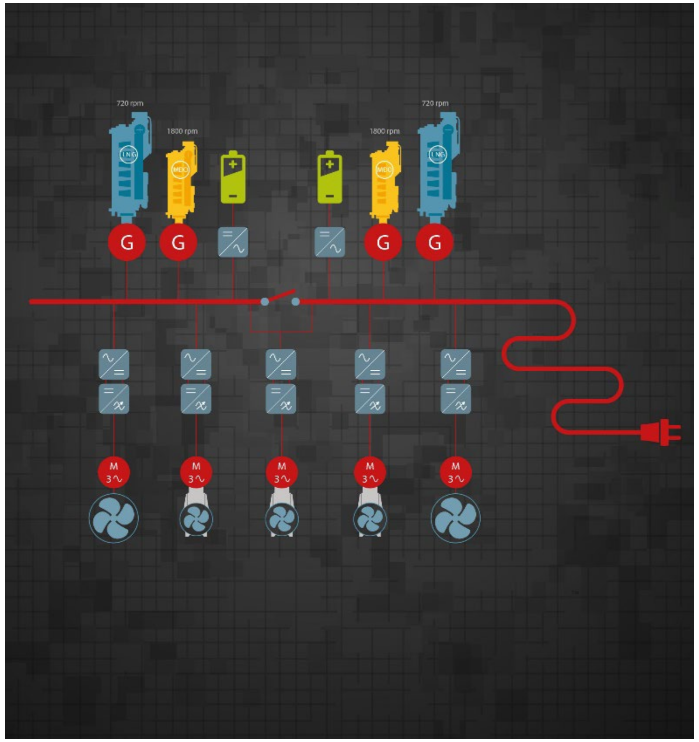


Further Reductions in Emissions & Noise

- Still require combustion engines to generate electrical power
- Energy generated by burning fossil fuels
- Air emissions: SOx, NOx, PM, CO_2
- Diesel engine limitations: noise, efficiency, varying loads
- LNG engine limitations: poor response
- Advances in battery based energy storage systems
- Development of the Electric Hybrid

Environmental and cost savings

Illustration



Environmental savings

- 15-25% Potential Fuel savings
- 25-30% reduction in NOx emissions
- 15-25% reduction in CO2e emissions

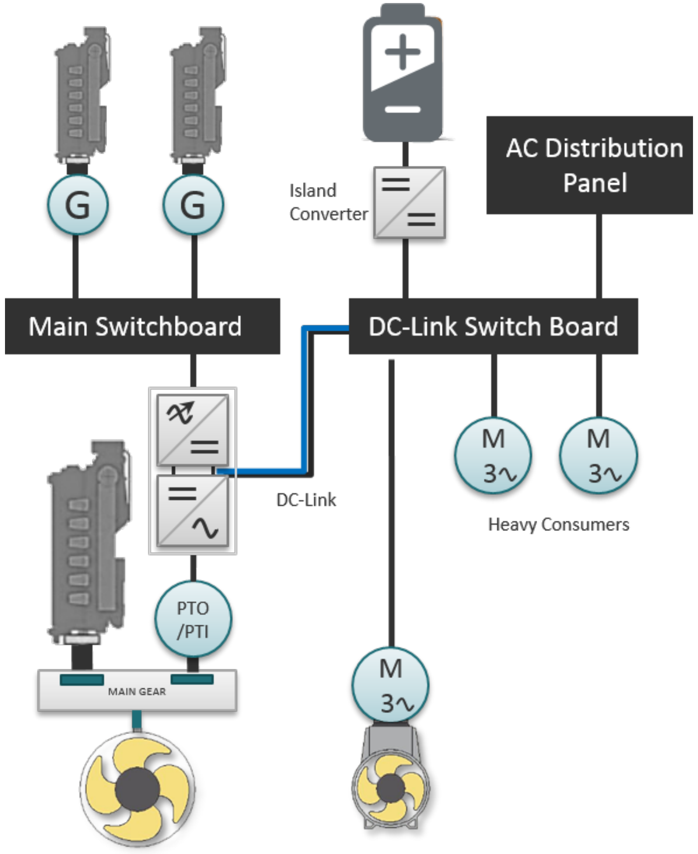
Source: DNV-GL

Cost savings

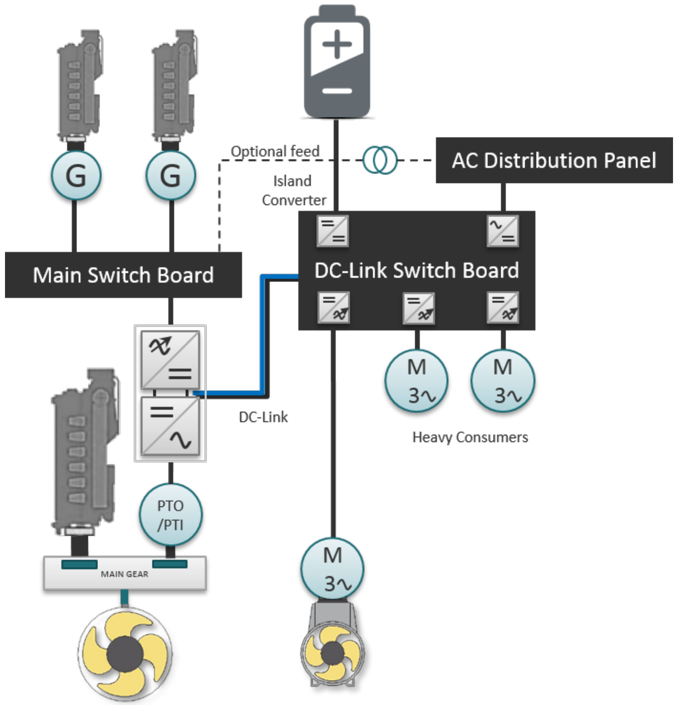
- Reduction maintenance
- Operational gains
- Faster response
- Reduced noise and emissions
- Less maintenance, more uptime engines

Optimal Power Distribution

System overview



System overview



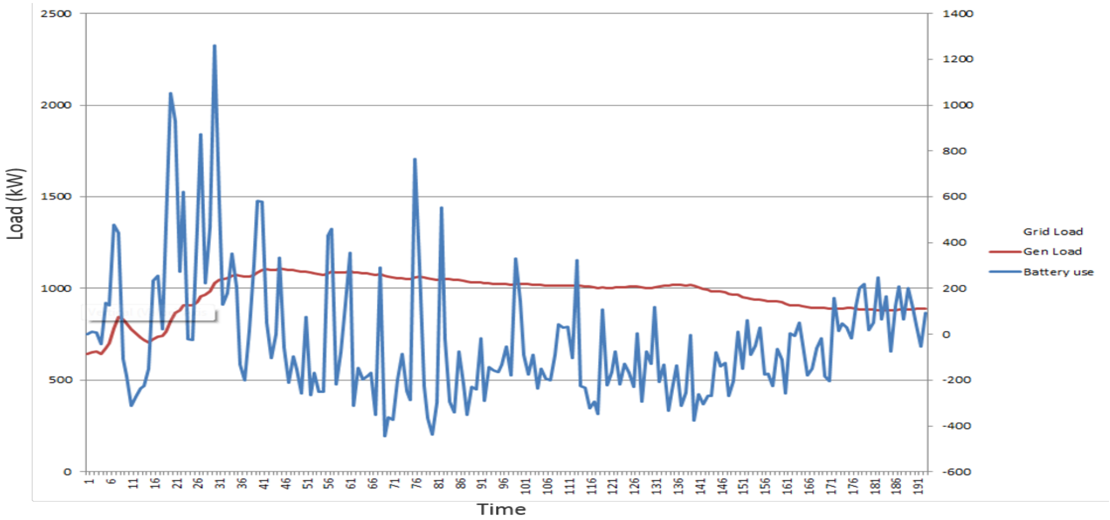
Description

- DC-Link distribution
- Distributes energy efficient and economical (only needs DC/AC part of drive)
- Enables lighter switchboards
- Heavy consumers have dedicated drive units connected to DC-link
- Power can be distributed to vessels traditional (AC)electrical network
- Enables controlled short circuit currents

Application areas

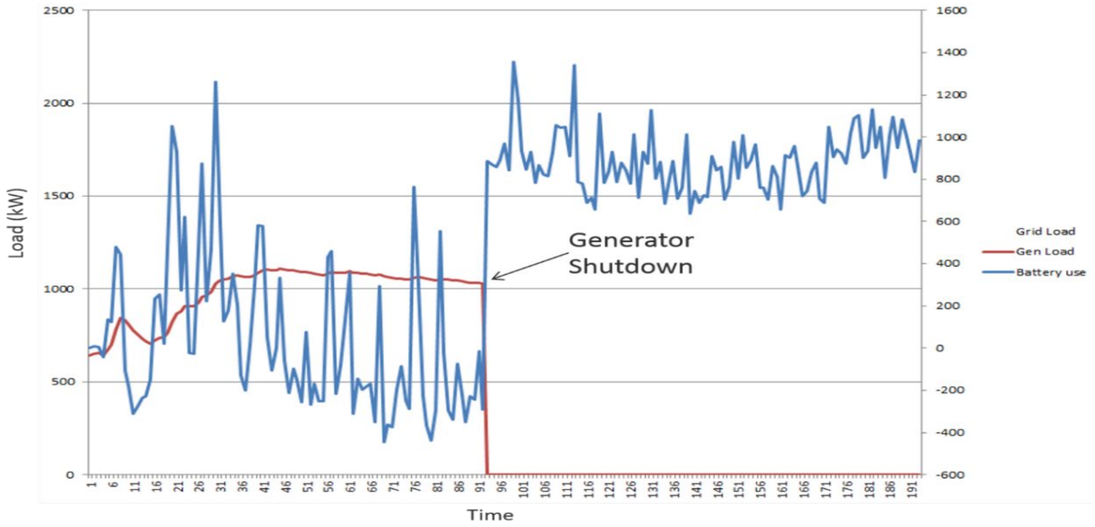
Peak Shaving

- Level the power seen by engines
- Offset the need to start new engine
- Improve fuel efficiency
- Reduce engine running hours

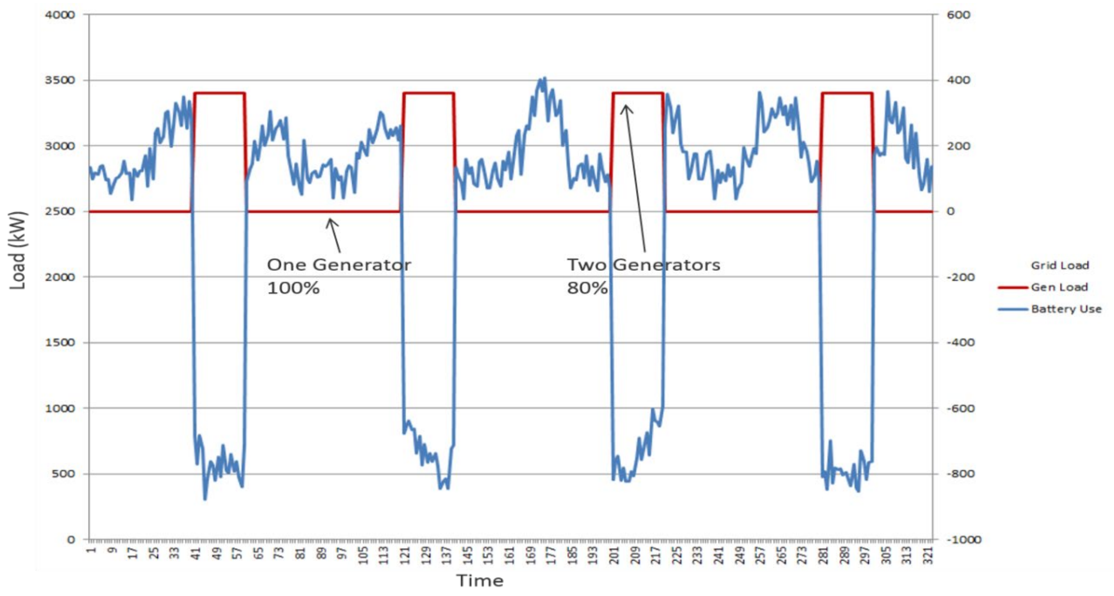


Spinning Reserve

- Backup for running genset
- Fewer engines needed online
- Improved fuel efficiency
- Reduced engine running hours



Application areas

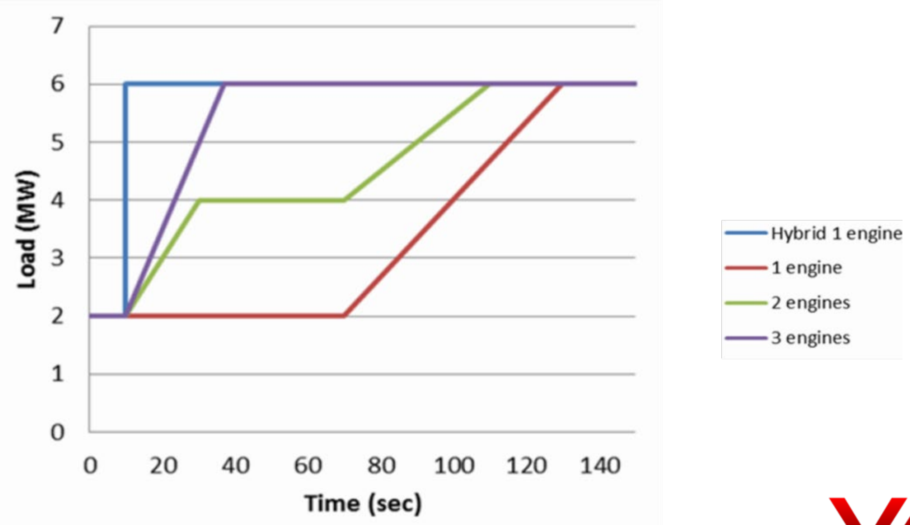


Strategic Loading

- Charging and discharging ES media in such a way that it optimises the operating point of the genset
- Power is produced at peak efficiency

Enhanced Dynamic Support

- Instant power in support of running genset
- Enable use if “slower” engines:
  - LNG/DualFuel engine
  - Fuel Cells



Application areas

Enhanced Ride Through

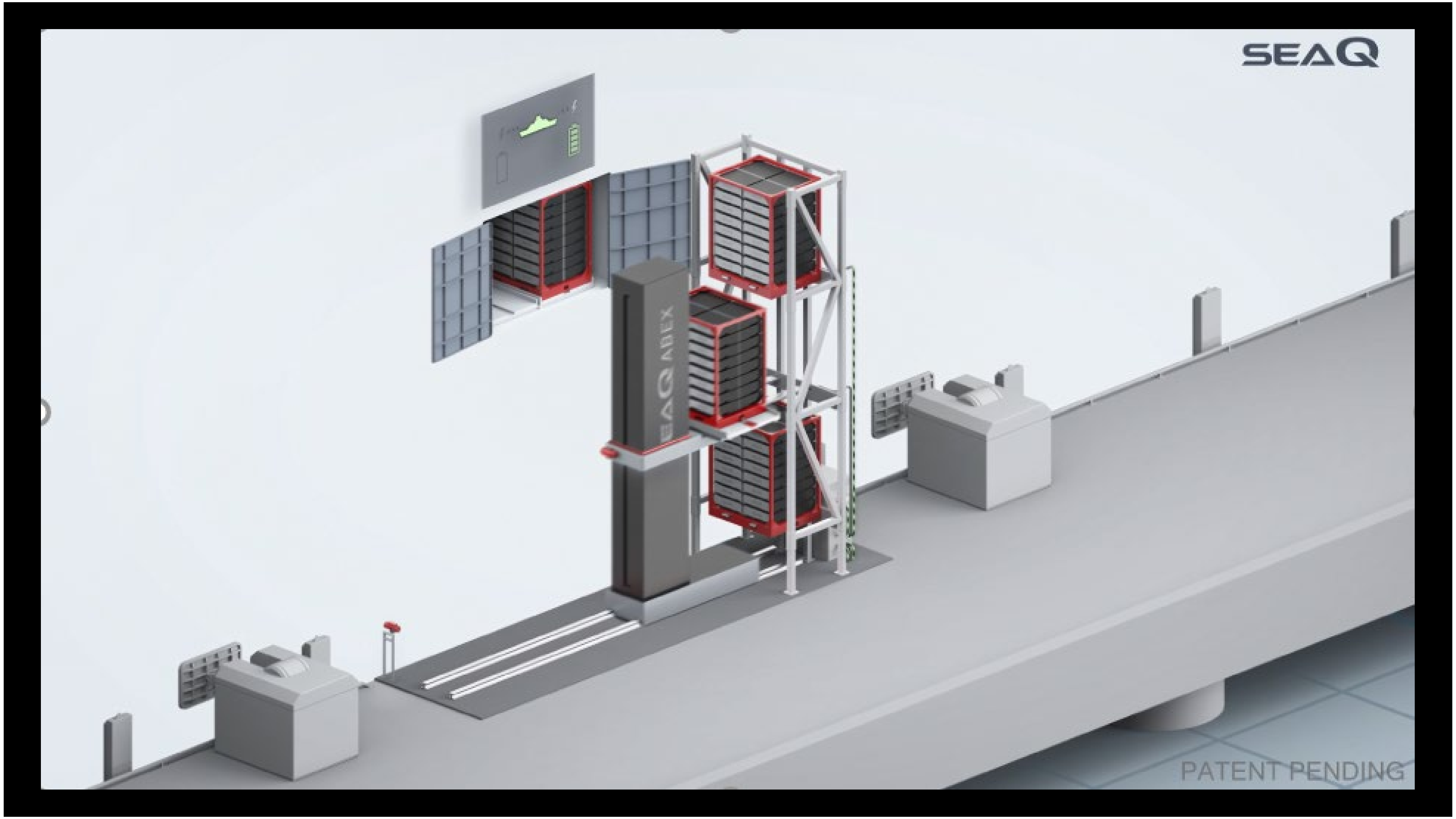
- ES solution can give UPS like functionality to the power system
- New way of achieving high ERN numbers
- Higher power system availability

Zero Emission Operation

- Zero emissions in harbour
- Quiet engine room
- Ferry operation

Zero Emission Challenges

- 1000 kWh energy requirement
- SIze
- Charging
- Ferry application:
  - Charge while car unload/load
  - 15 minutes
  - 4 MW charge power


SEAQ
SEAQ ABEX
PATENT PENDING

Life time

Dimensioning

- Degradation / Fade After 10 Years
- Spare / Margins
- Actual Energy Needed

Degradation due to

- Cycling
- Cycling Depth And Cut Of Voltage
- Calendar Effect
- Cell Temperature
- Charging \ Discharging Rates

Equipment

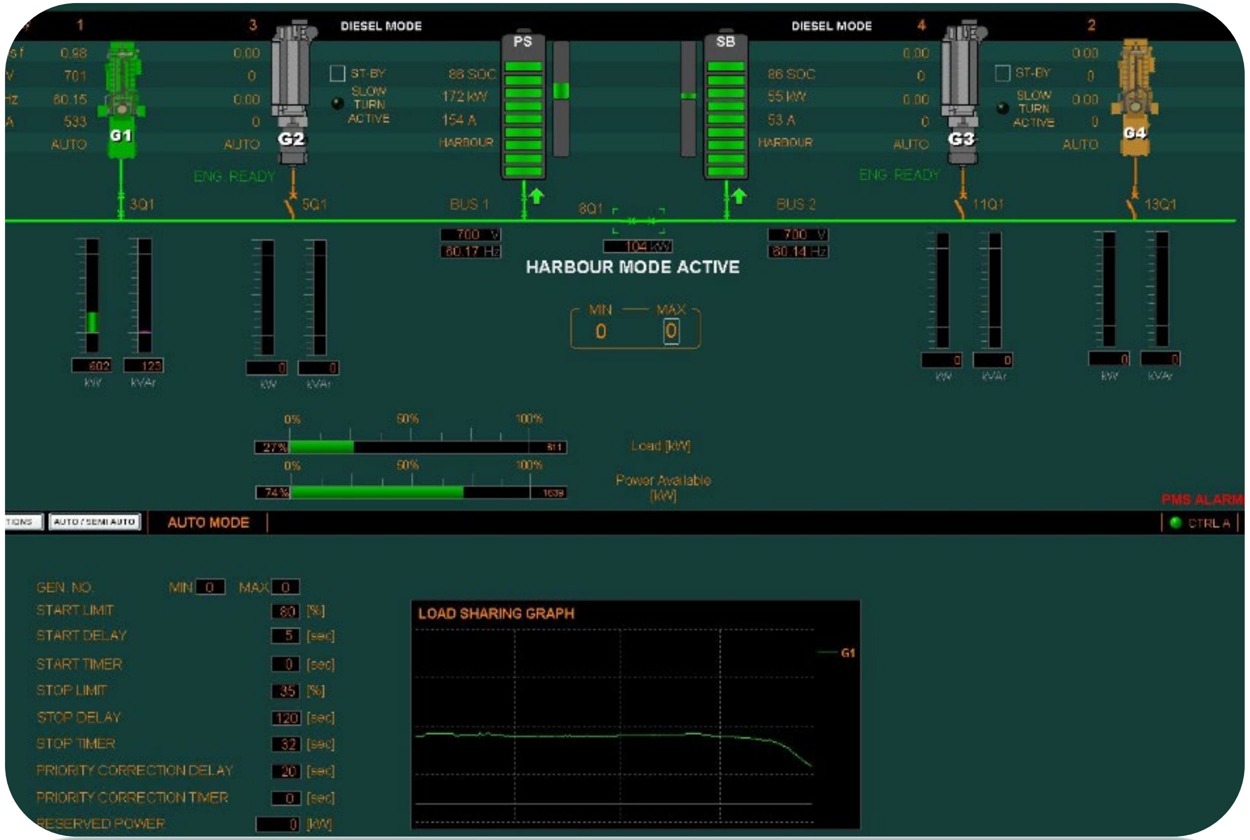
Battery Rack

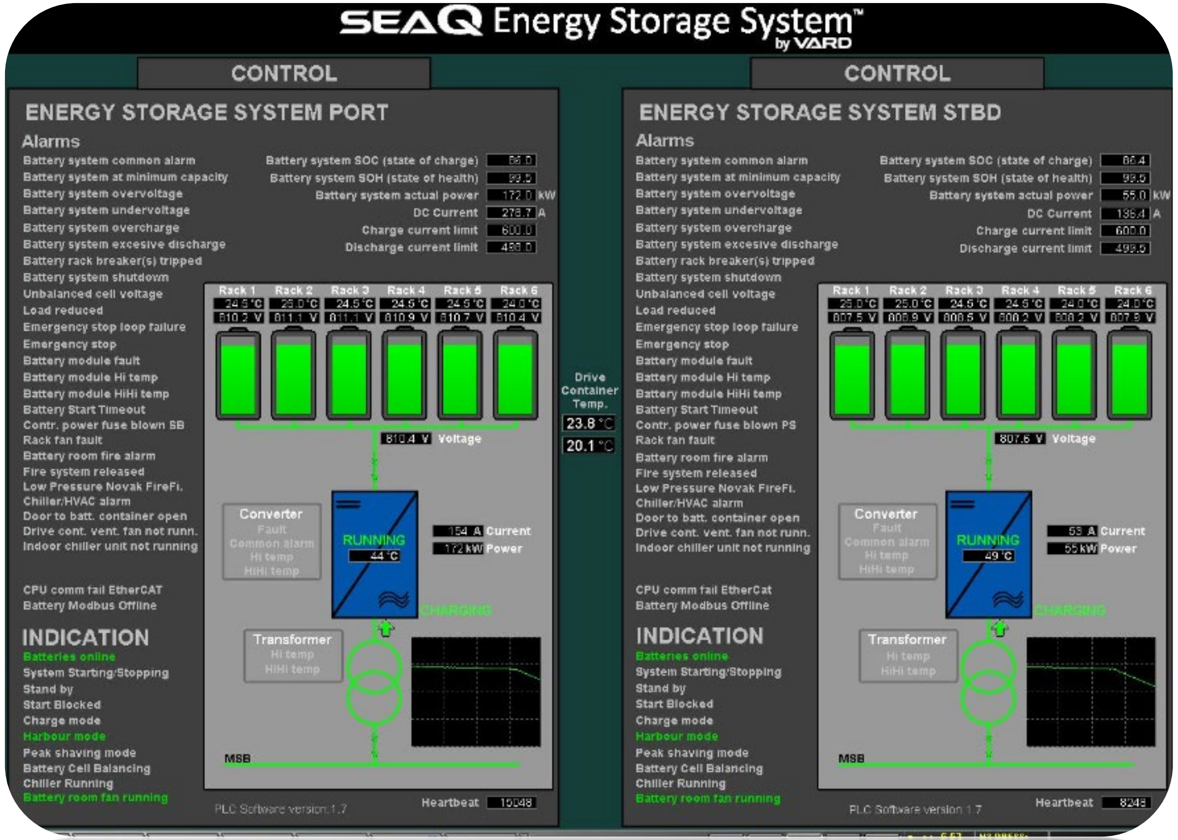
Battery Charger

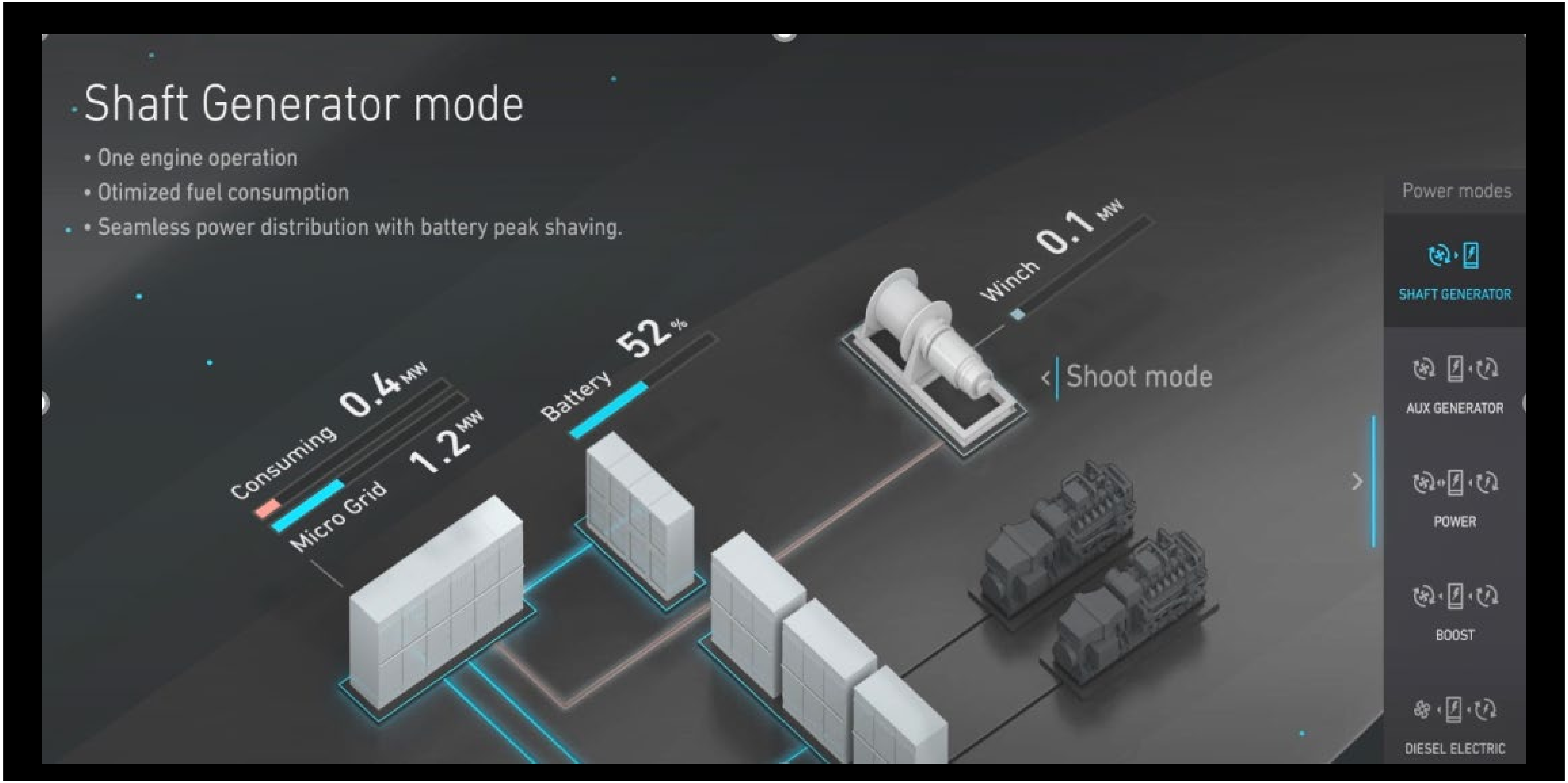
Considerations

- Closed loop air cooled batteries
- Air conditioned room
- Watermist Fire Fighting System
- Battery Power – Battery Safety

Human Interface and Automation






Shaft Generator mode
• One engine operation
• Otimized fuel consumption
• Seamless power distribution with battery peak shaving.
Consuming 0.4 MW
Micro Grid 1.2 MW
Battery 52 %
Winch 0.1 MW
Shoot mode
Power modes
SHAFT GENERATOR
AUX GENERATOR
POWER
BOOST
DIESEL ELECTRIC

Bridge Navigation and Accommodations

- Human interface, comforts
- Conveniences: TV, radio, internet, networking, telephones
- CCTV, public address systems
- Radio communications, navigation, mapping, nav lights,
- Monitoring and controls for the operators


SEAQ

Automation Integration

- Integration of the different equipment and systems especially between the power and controls
- Power management system: protection, coordination
- Advent of ASDs (VFDs) for precise control of electrical motors
- Sensors: speed, position, GPS
- Dynamic positioning

Opportunities

- Environmental Sustainability
- Other countries such as Norway have mandated the use of clean technology in all of their new vessels
- IMO's requirement for reducing greenhouse gases
- Human Sustainabilty
- Putting humans out of harm's way
- Solution: Autonomous Ships


ZERO
EMISSION
YARA
YARA
BIRKELAND

Opportunities

- Need for electrical engineers that have marine knowledge with the ability to work in a multi-discipline environment
- Vard supports UBC's decision to award funding to support establishment of a Marine Systems Research Cluster at UBC

Thank you for your attention