www.zeetug.com

ZEETUG®

Zero Emission Electric Tug Boat

Designer & Builder

NAVTEK

NAVTEK NAVAL TECHNOLOGIES INC.

THE WORLD'S FIRST
ALL ELECTRIC TUGBOAT

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NAVTEK
NAVAL TECHNOLOGIES INC.

Our extensive know-how is based on our experience, since 1977...

A proud history for more than 40 years in service and is among the highest reputable companies in Turkish shipbuilding industry. NAVTEK focus on delivering innovative unique designs and engineering solutions with the best available technologies and know-how.

NAVTEK is not only a design and engineering company, but a technology firm with innovative R&D activities and cooperates with respected Universities and high-technology institutions.

By a legacy of more than four decades of design and engineering experience, we offer a large design portfolio, each tailored specifically to the defined needs of our clients. Our know-how covers the simplest barge to sophisticated ships.

Member of

ZESTAs. Zero Emission Ship Technology Association | WATERBORNE | world hydrogen leaders

SELECTED PROJECTS PORTFOLIO

POWER PLANTS

Designer of the first self-propelled Floating Power Plants in the world

LANDING SHIP TANKS

Designer of Turkey's biggest landing ship tanks (LST)

VIRAZON II

Designer and builder of the world's most advanced underwater archaeological research ship VIRAZON II for INA (Based in USA)

ZEETUG

Designer and builder of the world's first zero emission all electric and re-chargeable harbor tugboat ZEETUG (GisaşPower)

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ZEETUG®

Zero Emission Electric Tug Boat

ZEETUG SUCCESSFULLY
FULFILLS HER DAILY **HEAVY - DUTY**
OPERATIONS IN LINE WITH **NOT HARMING**
THE ENVIRONMENT OVER **THREE YEARS**

ZEETUG®

Zero Emission Electric Tug Boat

ZEETUG represents the new generation green and high technology by being re-chargeable and all electric with zero emission and no noise. This innovative design allows the vessels to operate powerful with higher efficiency in line with not harming the environment.

With the aid of the modular system ZEETUG can be custom build from 5T BP up to 80T BP.

ZEETUG is also a smart harbor tugboat; a power efficient electric tugboat, capable of managing its energy and reach on longer distances.

ADVANTAGES

ECO FRIENDLY
LOW NOISE
NO EMISSION

BUDGET FRIENDLY
UP TO 85%
LOWER OPEX

SMART
MANAGING ITS ENERGY
& ONLINE DIAGNOSTIC

POWERFUL
HIGHER
MANEUVERING ABILITY

SAFE
MEETS ALL IACS MEMBERS'
VALID RULES AND REGULATIONS

Designer & Builder

NAVTEK NAVAL TECHNOLOGIES INC.

ZEETUG MEANS;

AN ALL ELECTRIC

NEW CONCEPT FOR

TUG OPERATORS

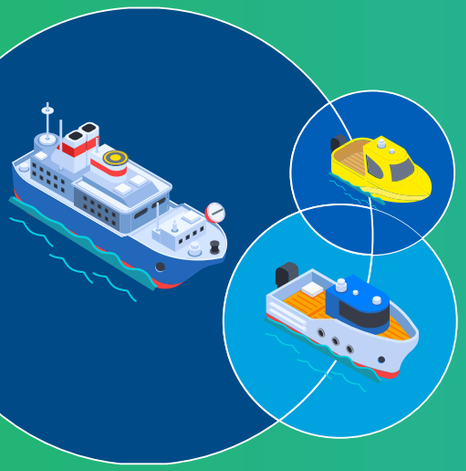
Awards

FOR HELPING
THE ENVIRONMENT
WINNER 2020

TUG
OF THE YEAR
WINNER 2021

GREEN
WORLD
AWARDS 2021

EXISTING SOLUTIONS
ZERO EMISSION @BERTH
RUNNER UP 2022



THE ZEE TECHNOLOGY

Lithium-ion battery packs are used to power up ZEETUG, manufactured by our solid solution partner green craft tech specialist CORVUS ENERGY.

By the powerful electrically charged battery packs ZEETUG successfully fulfills her daily heavy-duty operations, in line with not harming the environment and enables the harbor tugboat to operate even at nighttime with almost no noise.

With the aid of the modular system ZEETUG can be custom build from 5T BP up to 80T BP.

This technology can be adapted to any existing short distance watercraft. Our expertise also includes Conversion and Refit.

- ✓ Ferry / Landing Craft
- ✓ Coastal Fishery Boat
- ✓ Leisure Boat
- ✓ Workboat
- ✓ Sea-taxi
- ✓ Any other special short distance watercraft

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ZEETUG®

Zero Emission Electric Tug Boat

WHY CUSTOM MADE?

Due to the variability of the weather conditions and operation times of the regions where the ports are located, we examine the profiles of our clients in order to obtain maximum efficiency.

We adjust the technical characteristics of ZEETUG according to the existing/requested operation profile of our clients. Thus, we ensure maximum protection of battery health and guarantee successful operations together with the NAVTEK STEMS software.

NEEDED INFORMATION TO BUILD YOUR ZEETUG

- Power requirements for the different operations.
- Distances to be sailed during the operations.
- How often the Tugs operate?
- How long an operation takes?

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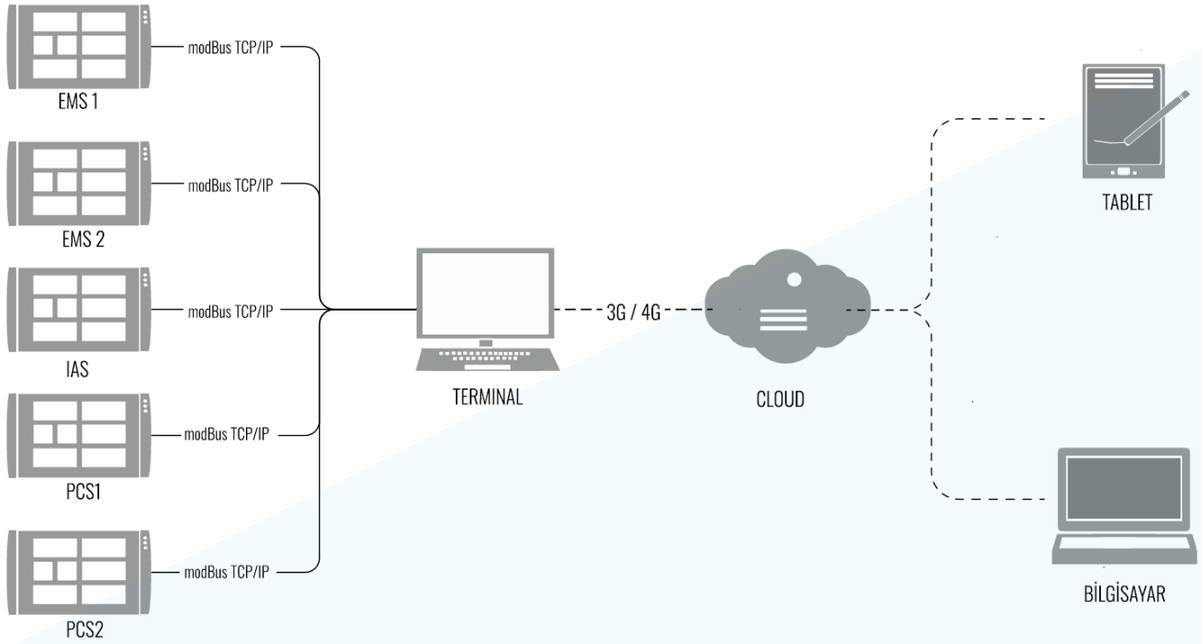
STEMS (SMART TUG ENERGY MANAGEMENT SYSTEM)

STEMS (Smart Tug Energy Management System) software is developed by NAVTEK NAVAL TECHNOLOGIES with the objective of optimizing the electric power consumption of the electric watercraft and extending its driving range and operation cycles.

STEMS is a browser-based software, which has a lot of capabilities for fleet control center and tugboat operators. With its flexible structure, it can be adapted to a fleet. STEMS collect all data coming from the devices and equipment in the tugboat and stores them in the Control Center's server.

- Tug speed,
- Motor speed,
- Power consumption,
- Battery motor temperature,
- Battery state of charge…
- Actual ambient condition's data
- Weather data

It uses the related data to performance, to optimize the electric power and gives feedback in terms of suggested actions to the operator.



ADVANTAGES

- STEMS can be used on more than one ZEETUG® (a whole fleet)
- Towage operations can be scheduled on considering the availability of the charged (ready to operate) ZEETUG®.
- The final charge of batteries can be estimated.
- Control center operator can change predefined route on chart.
- Any type of mobile communication tool (tablet, smart phone etc.) can be used.
- All data coming from the ZEETUG® are being stored in Cloud.
- STEMS can prepare reports of all operational output.
- Due to the possible operational profile changes the software can be revised…

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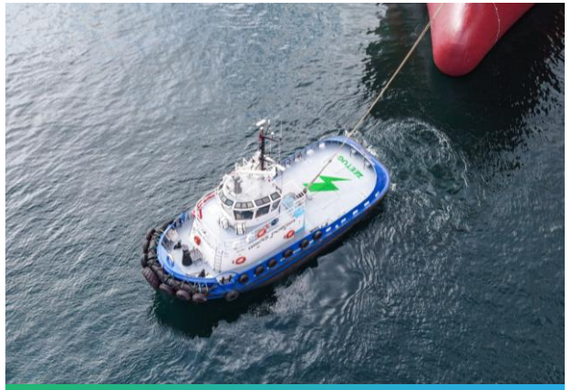
ZEETUG FLEET



NV712-ZEETUG30
IN OPERATION

Lenght (O.A)	Abt.	18.70 m
Breadth (MLD)	Abt.	6.70 m
Depth (MLD)	Abt.	4.65 m
Draught (Design)	Abt.	3.50 m
Speed at Design Draught		10 knots
Electric Motor		2x925 kW
Personel Number		4 Persons

NV717-ZEETUG30
IN OPERATION

Lenght (O.A)	Abt.	18.70 m
Breadth (MLD)	Abt.	6.70 m
Depth (MLD)	Abt.	4.30 m
Draught (Design)	Abt.	3.15 m
Speed at Design Draught		10 knots
Electric Motor		2x925 kW
Personel Number		4 Persons

NV719-ZEETUG45
IN OPERATION

Lenght (O.A)	Abt.	26.20 m
Beam (MLD)	Abt.	10.60 m
Depth (MLD)	Abt.	4.32 m
Extreme Draught (MLD)	Abt.	4.55 m
Estimated Top Speed		12 knots
Electric Motor		2900 kW
Personel Number		8 Persons

NV720-ZEETUG30
IN OPERATION

Lenght (O.A)	Abt.	18.70 m
Breadth (MLD)	Abt.	6.70 m
Depth (MLD)	Abt.	4.30 m
Draught (Design)	Abt.	3.15 m
Speed at Design Draught		10 knots
Electric Motor		2x925 kW
Personel Number		4 Persons

This product's technical characteristic is designed in accordance with Gisaş Shipbuilding Industry's operation profile. The technical configuration of ZEETUG may vary according to project requirements / operation profile.

Designer & Builder

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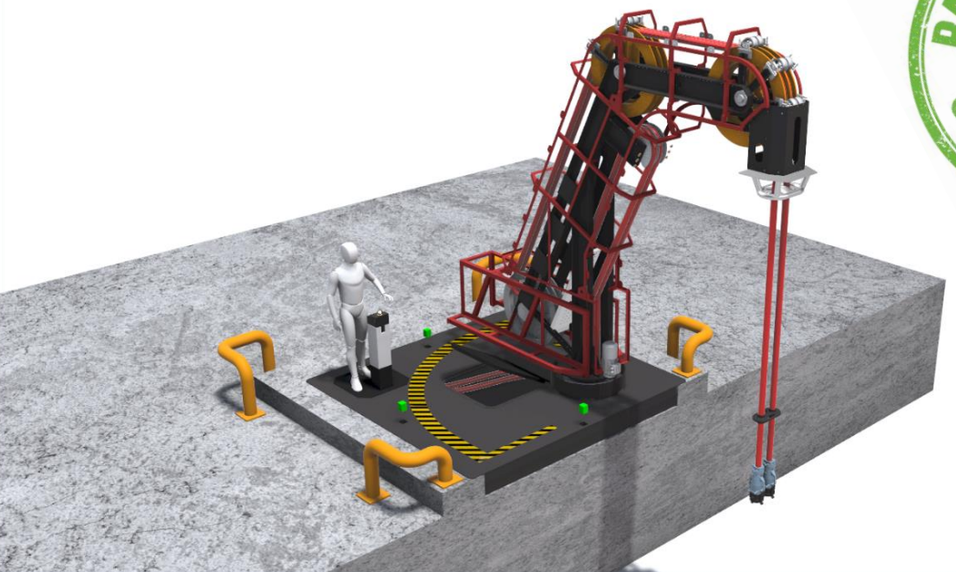
QCS
(QUICK CHARGE STATION)

This product is developed in accordance with the infrastructure of Tuzla Harbor, Turkey and ZEETUG30 (NV712).

* The technical configuration of QCS may vary according to project requirements and to the port infrastructure. The Quick Charge Station is designed (tailor-made) for ZEETUG® by NAVTEK NAVAL TECHNOLOGIES INC.



PATENTED PATENTED

GENERAL SPECIFICATIONS

Input	3- phase 500VAC ±10% ; 50-60Hz ±%5
Output	750Vdc
Efficiency	>96%
Power factor	0.99
Output power up to	2x500 KW
Protection degree	IP54 Cabinets for indoor use
Ambient temperature	0°C to 40°C
Ambient humidity	0% to 95%
Heating/Cooling is controlled	by A/C inside container
Dimensions (W x D x H)	1500 x 650 x 2250 mm

CHARGING TECHNOLOGY

Swich board	ABB
Cooling system	Air cooling
Optimizing	Boosting input voltage according to set output voltage, active power control and limit functions
Human machine interface	Hand terminal used as HMI, actual readings of power, voltage, current, temperature, ect.
Energy import	Energy import is recorded for each charging cycle in kWh

CONNECTORS

Marechal DS4 1000 V

BATTERY OPERATION RANGE

%20-%90 SOC for ZEETUG NV712 : 995 KWH, 55-65min

BE A PART OF THE SOLUTION, NOT A PART OF THE POLLUTION

LET'S MOVE TOWARDS GREEN TO KEEP THE PLANET CLEAN

THERE IS NO PLANET '' B ''

NAVTEK NAVAL TECHNOLOGIES INC.

NOT ONLY DESIGN, BUT ALSO BUILD AND DELIVER TURNKEY!

KIRAN HOLDİNG A.Ş.

Group of Companies

PASİFİK GEMİ İŞLETMECİLİĞİ VE TİCARET A.Ş. SHIP MANAGEMENT & TRADING S.A.

TK TUZLA shipyard

ERKAL Uluslararası Nakliyat ve Tic. A.Ş.

TK TUZLAPORT shipyard

HANBULK

NAVTEK NAVAL TECHNOLOGIES INC.

STATE OF ZEETUG AVAILABLE SERIES

5T BP up to 80T BP

Bollard Pull (t.)	5T BP	30T BP	45T BP	55T BP	60T BP	65T BP	70T BP	75T BP	80T BP
Loa(m.)	11	18,7	25,5	27	27,9	28,7	29,6	30,5	31,4
B(mld.m.)	4,4	6,7	10,6	10,8	11,1	11,4	11,8	12,1	12,5
H(mld.m.)	2,06	4,65	4,27	4,7	4,9	5	5,2	5,3	5,5
T(bl.m.)	1,7	3,5	3	3,45	3,5	3,55	3,6	3,65	3,7
Total Motor Power (kW)	300	1900	2900	3440	3800	4100	4400	4700	5000
Propellers (n)	2	2	2	2	2	2	2	2	2
Propeller diameter (mm.)	1000	1800	2200	2300	2400	2500	2600	2700	2800
Steering Type	asd	conv.	asd	asd	asd	asd	asd	asd	asd
Endurance@6 knots abt.	6h:18m @ 38 nm	5h:18m @ 31.8 nm	9h:30m @ 57.1nm	10h:30m @ 63.3nm	9h:54m @ 59.2 nm	10h:48m @ 64.8 nm	10h:6m @ 60.4 nm	9h:24m @ 56.2 nm	10h:0m @ 60 nm
Endurance@7 knots abt.	3h:12m @ 22.1 nm	3h:54m @ 27.1 nm	7h:42m @ 54.1 nm	8h:36m @ 60.4 nm	8h:0m @ 58.3 nm	8h:48m @ 61.4 nm	8h:12m @ 57.1 nm	7h:30m @ 52.7 nm	8h:0m @ 55.9 nm
Endurance@8 knots abt.	2h:6m @ 16.9 nm	2h:48m @ 22.2 nm	6h:30m @ 52 nm	7h:18m @ 58.5 nm	6h:48m @ 54.2 nm	7h:24m @ 59 nm	6h:54m @ 54.8 nm	6h:18m @ 50.3 nm	6h:36m @ 53.1 nm
Endurance@9 knots abt.	1h:12m @ 10.4 nm	1h:48m @ 16 nm	4h:30m @ 40.1 nm	5h:6m @ 45.9 nm	4h:42m @ 42.6 nm	5h:12m @ 46.4 nm	4h:48m @ 43.3 nm	4h:24m @ 40 nm	4h:42m @ 42.5 nm
Endurance@10 knots abt.	0h:48m @ 7.9 nm	1h:18m @ 13.1 nm	3h:24m @ 33.9 nm	3h:54m @ 39.2 nm	3h:36m @ 36.4 nm	4h:0m @ 39.7 nm	3h:42m @ 37 nm	3h:24m @ 34.3 nm	3h:42m @ 36.6 nm
Estimated top speed (knots)	10,2	11,3	13,3	13,2	13,1	13,1	13	12,9	12,8
Proposed crew number	2	4	6	7	7	7	7	8	8

Designer & Builder

NAVTEK NAVAL TECHNOLOGIES INC.

HYDROTUG

Zero Emission Hydrogen Powered Tugboat

Award

maritimes cluster norddeutschland

PROTOTYPES
ZERO EMISSION @BERTH
RUNNER UP 2022

ZERO EMISSION HYDROGEN-POWERED ALL-ELECTRIC / HYBRID ASD TUGBOAT

Designer & Builder

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HYDROTUG60

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NAVTEK NAVAL TECHNOLOGIES INC.

LOA	28.50 m
BREADTH	12.50 m
DEPTH	4.90 m
BP	60.00 TBP
SPEED (max)	12+ knots
SPEED (cont)	9 knots (with FC)
Main Engine	2x2000 kW E-motor
Propulsion	2xASD, L-drive
Batteries	2x1085 kWh 3C/3C Corvus Orca
FC	2x500 ekW at (EoL)
External Fire Fighting	FiFi-1
Escort capability	Available

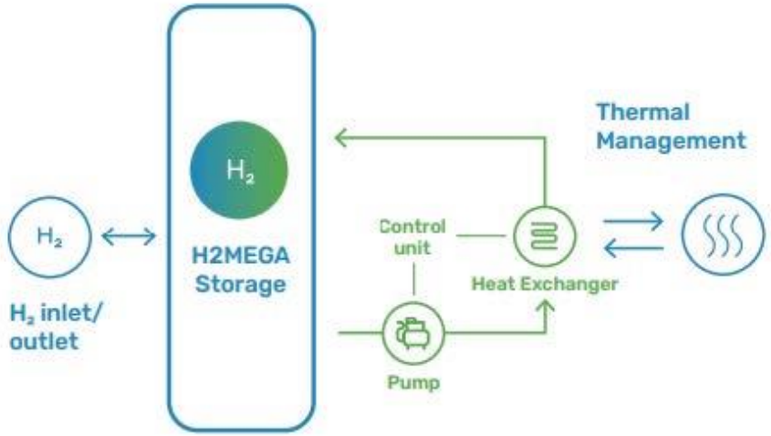
H2YDROTUG60

Designer & Builder
NAVTEK NAVAL TECHNOLOGIES INC.

Hydrogen storage on board	1000 kg @ 40 bar, GKN
H2 Refueling time	4 hours
Battery charging time	2 hours (SoC 10%-->90%) from QCS[1]
Operational Profile	20 hours daily usage. 1 x Refueling per day 1 x Charging per day H2YDROTUG has been designed for busy ports. (average power usage up to 25%)
Maximum Pull (30 mins continuous)	60 TBP
Continuous Pull with FC	13+ tbp (~21% of maximum pull)
Range @10 knots	100+ nm
Range @8 knots	200+ nm
Range @6 knots	300+ nm
CO2 reduction	Up to 2645 tonnes per year[2]
NOX reduction	Up to 8.29 tonne per year[2]
PM10 reduction	Up to 949 kg per year[2]
PM2.5 reduction	Up to 759 kg per year[2]

[1] : Quick charge station
[2] : In accordance with one refuelling per day and 5000 working hours per year

GKN HYDROGEN GmbH, Germany



Hydrogen storage capacity / unit
up to 250 kg (units can be clustered/stacked)

Energy storage capacity / unit
> 8.3 MWh

Dimensions
6.0 m x 2.5 m x 2.6 m

Transport weight
32,000 kg

Operating weight
35,000 kg (Cooling water approx. 2-3 tons)

Storage unit transportable by
Truck, ship & train

H2 loading/deloading mass flow
up to 65 kg H2/h

Pressure range
0.5 – 40 bar(g)

Temperature range
Cooling: 5 – 25°C
Heating: 55 – 90°C

H2 quality spec.
5.0 – (99.999%)

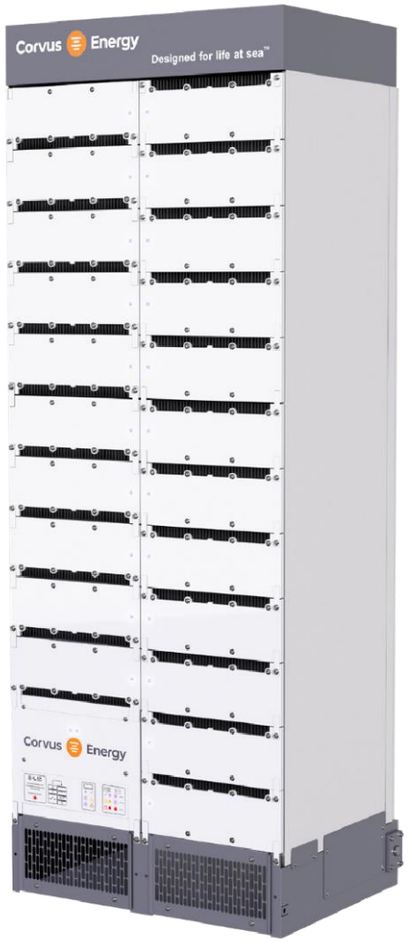
Ad-/ Desorption energy
~4 kWh / kg H2

NEDSTACK PEM FUEL CELLS, Netherlands

GENERAL	Fuel Cell Type	Low Temperature Proton Exchange Membrane (LT-PEM)
	Fuel Cell Model	60 x Nedstack FCS 13-XXL
ELECTRICAL	Nominal Power	500 kW_e
	Peak Power (BoL)	626 kW_e
	Voltage range	500 - 1000 VDC
	Current range	0 - 1200 A
ENCLOSURE	Weight	15.000 kg
	Built Level	20 ft ISO Container (High Cube)
	Length	6.06 m
	Width	2.44 m
	Heigth	2.90 m
	IP-rating	IP 54
HYDROGEN FEED	Quality	Grade ≥ 2.5 (CO < 0.2 ppm)
	Supply pressure	0.3 – 6 barg
	Nominal consumption (BoL)	59 kg/ MWh_e
	Max consumption	40 kg/h
COOLANT	Medium	DI water or BASF FC G20
	Outlet Temperature	Max 65 °C
	Required Cooling Capacity	900 kW_{th}
	Recoverable heat	>400 kW_{th}
AMBIENT CONDITIONS	Operating Temperature	-10 - 40 °C
	Storage Temperature	5 - 60 °C (optional -20 °C – 60 °C)
APPLICATION	Intended use	Main Propulsion Power for smaller vessel APU Source for Larger vessel
	Placement	Containerized when on open deck Skid based integration below deck
	Balance of Plant	20 years
	Stack Refurbishment	24k - 30k running hours
COMPLIANCY	Standards	Class Approval on Request IEC-60092 IEC-60529 IEC-60533

CORVUS ENERGY, Norway

Performance Specifications	
C-Rate - Peak (Discharge / Charge)	Project Specific Values
C-Rate - Continuous (Discharge / Charge)	Up to 3C / Up to 3C
System Specifications	
Single Module Size / Increments	5,6 kWh / 50 VDC
Single Pack Range	38-136 kWh / 350-1200 VDC
Max Gravimetric Density - **Pack**	77 Wh/kg | 13 kg/kWh
Max Volumetric Density - **Pack**	88 Wh/l
General Specifications	
Class Compliance	DNV GL, Lloyds Register, Bureau Veritas, ABS, RINA
Type Approval	DNV GL, Bureau Veritas, ABS, RINA
Ingress Protection	System: IP44
Cooling	Forced air
Vibration and Shock	UNT38.3, DNV 2.4, IEC 60068-2-6
EMC	IEC 61000-4, IEC 60945-9, CISPR16-2-1



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