



# GRIC Activities in Singapore

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# Why Singapore?

## Ideal as R&D Centre

- Maritime Nation
- Government Funding Support
- Spore as R&D Hub

## Business

- Ease of Business Setup
- Financial Assistance
- Ease of IP application & IP security

## Experience

- Marine & Offshore expertise
- Major shipping companies in Spore
- Port Hub

## Knowledge

- IHL's & Research Institute
- Existing skilled manpower
- Future manpower development

# The establishment of our new **Global Research & Innovation Center** in Singapore brings huge opportunities for global R&D

## Global Research & Innovation Center (GRIC)

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- ClassNK's **first** R&D Center located outside of Japan
- Dedicated to carrying **out new research** to support a **smarter, greener, and safer** maritime industry
- Will carry out joint R&D projects with **partners in Singapore and Globally**



# GRIC R&D Main Thrust

## Maritime Technologies R&D

### Focus Areas:

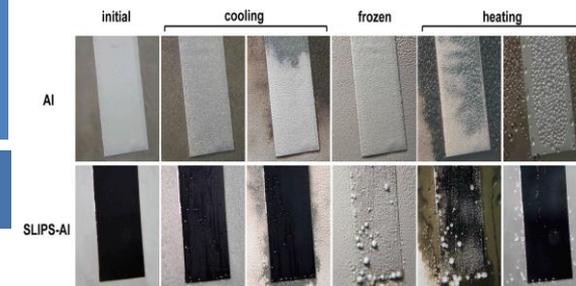
Safe & Smart Ships  
 Eco Friendly Ships  
 Anti Fouling  
 Maritime ICT

Autonomous Technologies

## Marine Renewable Energy R&D

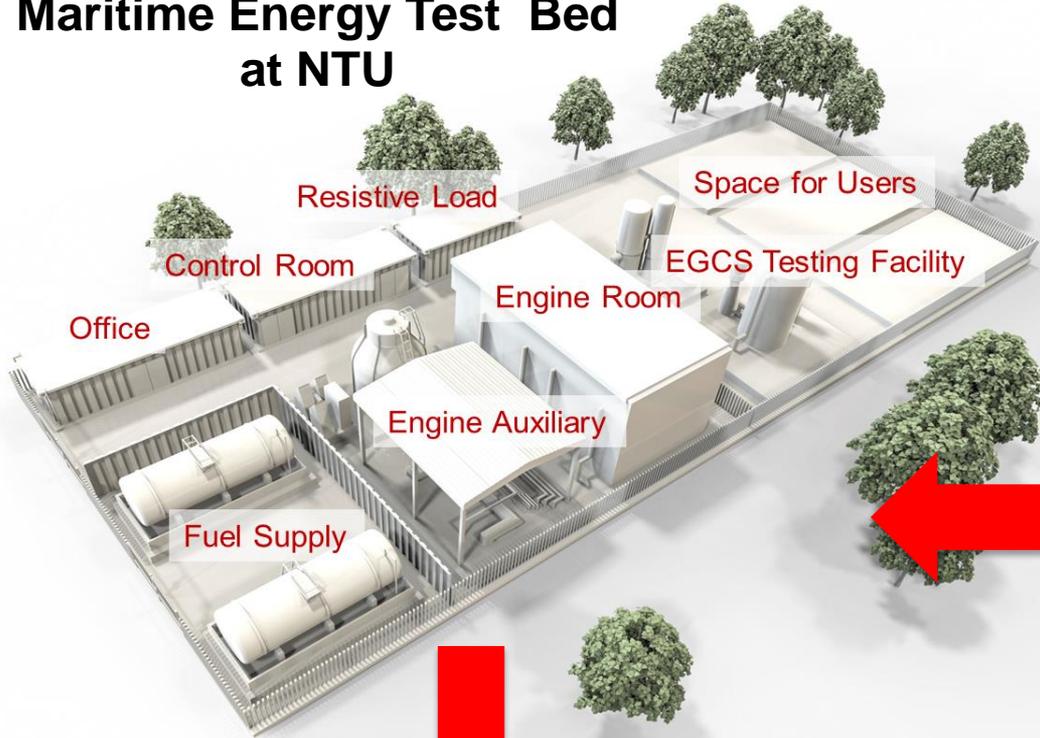
### Focus Areas:

Energy Storage  
 Effects on Ecosystem  
 Biofouling for the tropics  
 Safe Deployment Technics  
 Transmission at Sea



# Maritime Technologies R&D

## Maritime Energy Test Bed at NTU



**Singapore becomes  
Centre of Excellence on R&D  
of Maritime Energy**

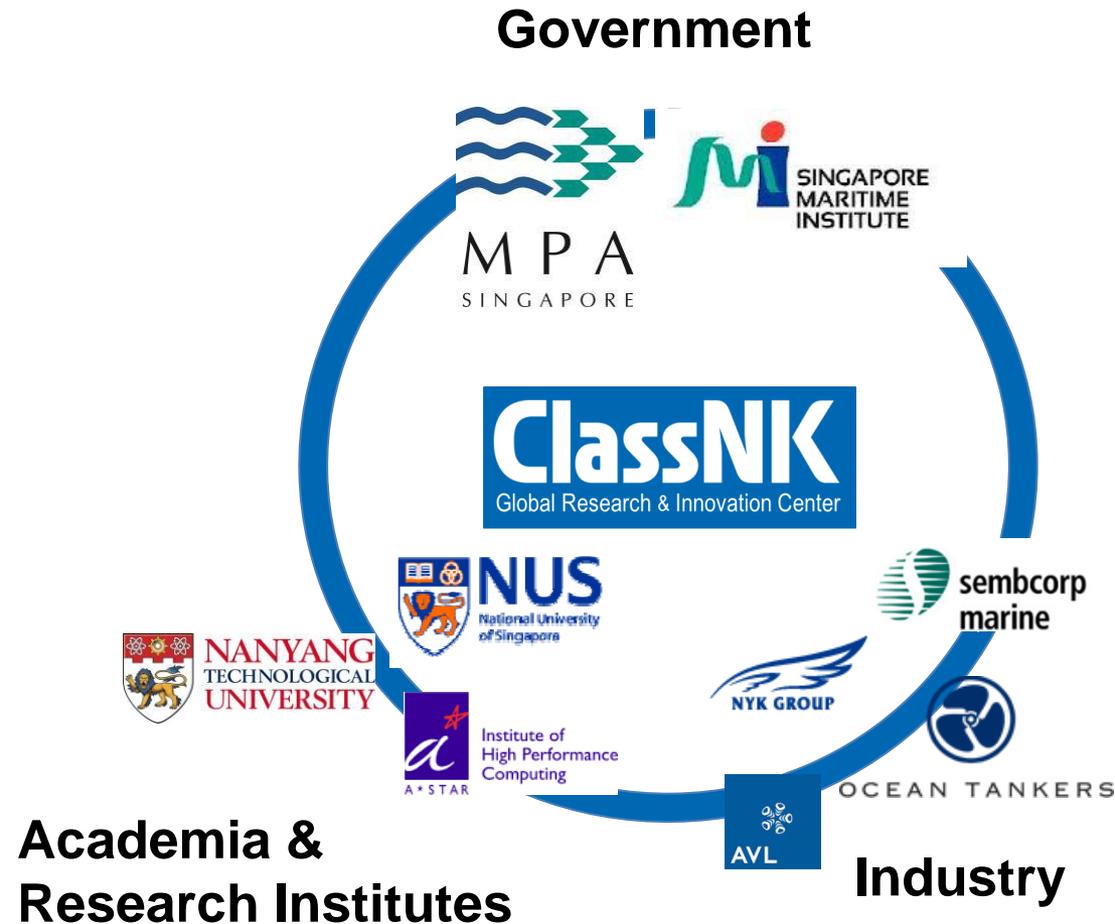


**collaboration**



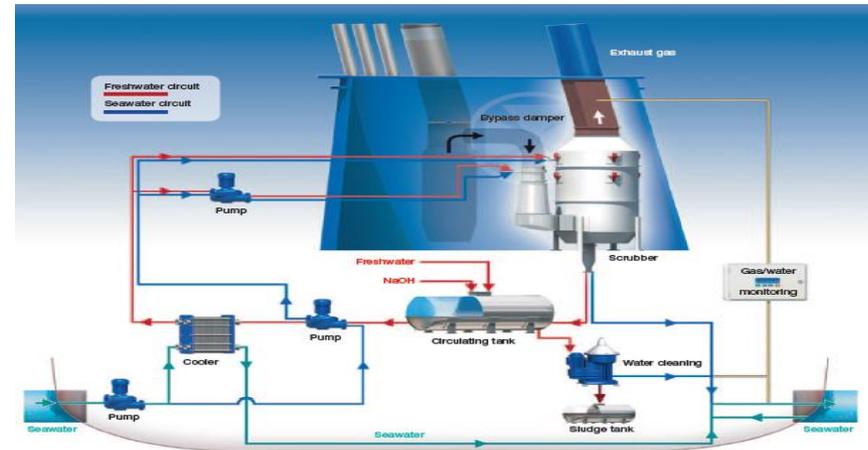
## Establishment of METB enhances ClassNK GRIC activities in Singapore with our partners locally and globally

- ClassNK is a **key supporter and user of METB** together with our partners locally and globally.
- Through ClassNK **Joint R&D for Industry Program**, ClassNK has supported 6 current and pending projects jointly with NTU and other major maritime stakeholders.



## Develop Total Solution for Exhaust Gas Cleaning System (EGCS) with the aim to comply with SO<sub>x</sub> emission standard in non-emission control area (0.5%S HFO)

### Collaboration Partners:



### Research Objectives:

1. To reduce the size and cost of existing EGCS to be suitable with SO<sub>x</sub> regulation in non-ECA
1. Development of a total solution of EGCS
  - Washwater treatment
  - Sludge handling at port
  - CO<sub>2</sub> reduction
3. Installation & Shipboard Trial



## Greener

Technologies to improve Energy Efficiency and to reduce emissions

Short Term Solutions

- Exhaust Emission Control  
ex. Exhaust cleaning system
- Energy Efficiency Technologies  
ex. Waste recovery and Use

## Truly Greener

Gas Engines/  
Alternative fuels

Mid - Term Solutions

- Gas Engine Conversion Kit  
ex. Existing ships to use gas
- Conversion Simulation
- Biofuel, GTL and Hydrogen

## Zero Emission

Electric Propulsion/  
Hybrid Power System

Long Term Solutions

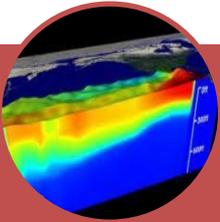
- Smart Power management for Hybrid & Full Electric Systems
- Energy Storage  
ex. Fuel cell

## Possible Collaborators



# Marine Renewable Energy R&D

## Various Methods to extract energy from the ocean



Thermal Gradient  
(OTEC)  
10,000 TWh/yr



Waves  
80,000 TWh/yr



Tides or  
Tidal Range (Barrage)  
300+ TWh/yr



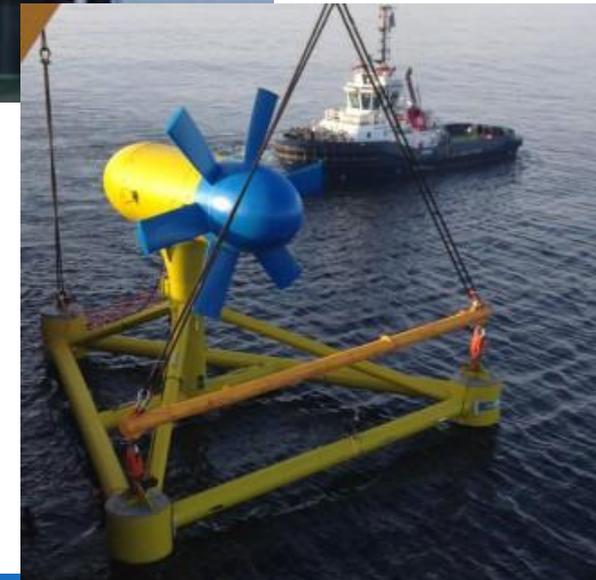
Tidal In stream Energy  
and  
Tidal / Marine Current  
800+ TWh/yr



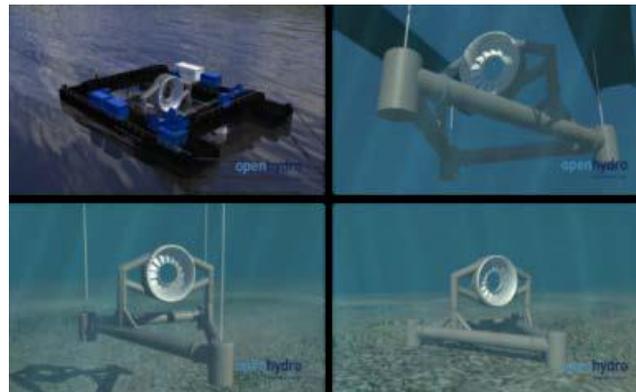
Salinity Gradient  
2,000 TWh/yr

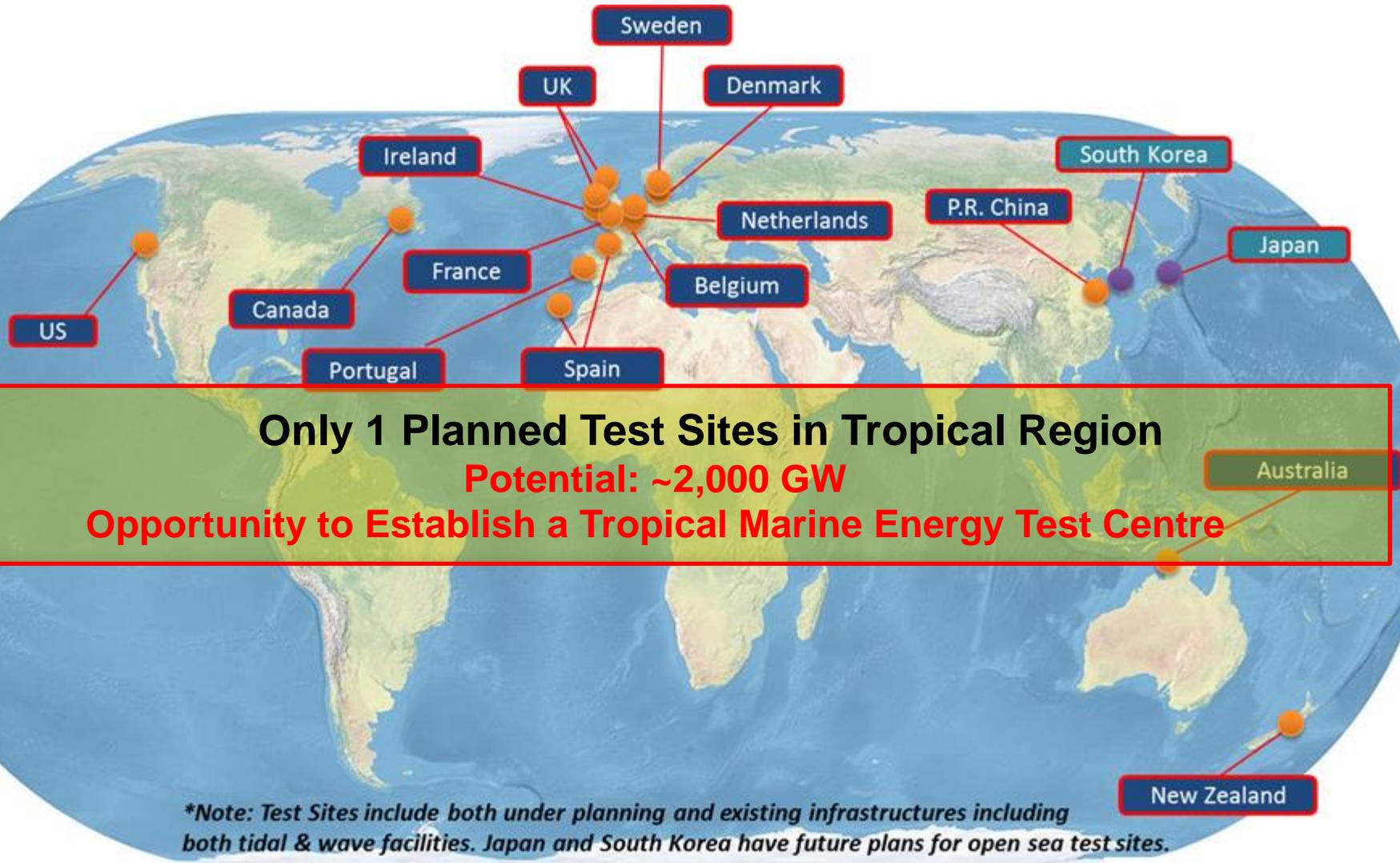
**Increase uptake in Tidal in stream Energy**  
Predictability  
Scalability  
Overall Investment

## Examples of Tidal Energy Devices deployed for Testing



- High cost of technology
- High upfront cost
- High Deployment Cost
- Environmental Concerns
- Widespread lack of awareness about the scale of resources available
- Grid Connectivity





**1<sup>st</sup> Stage: ClassNK funds and supports a feasibility study for the planning and development of the test site in Singapore.**

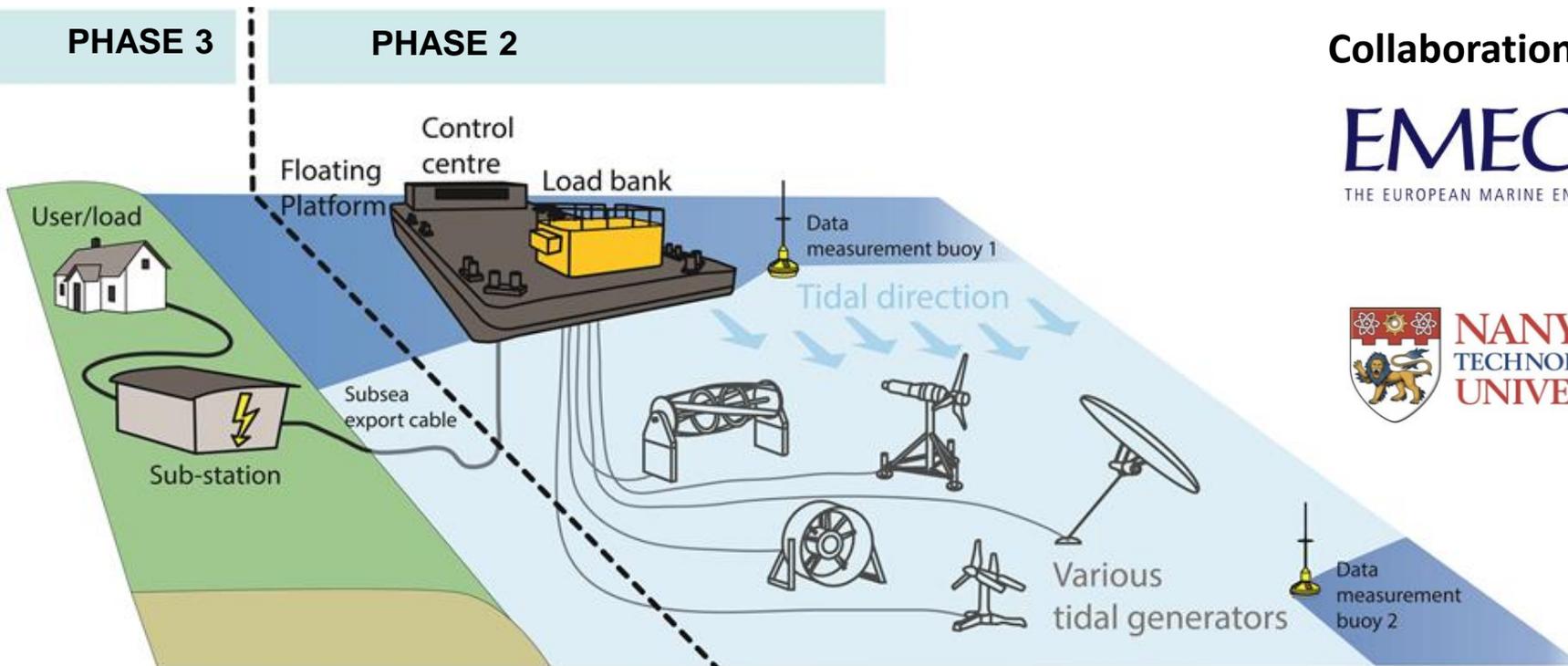
- **Site & Resource Assessment (Southern Singapore)**
- **Environment Impact Studies & Risk Assessment**
- **Tidal In-Stream Site-Device Studies**

Funded by:

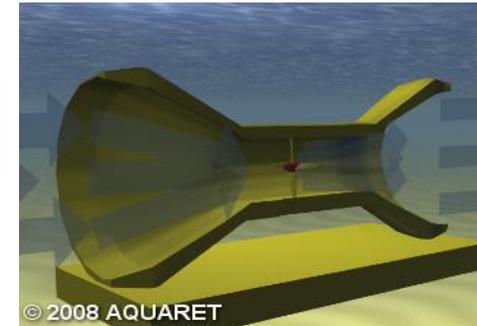
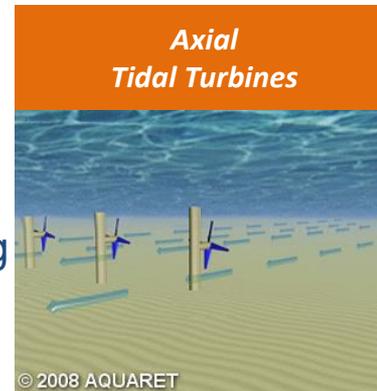
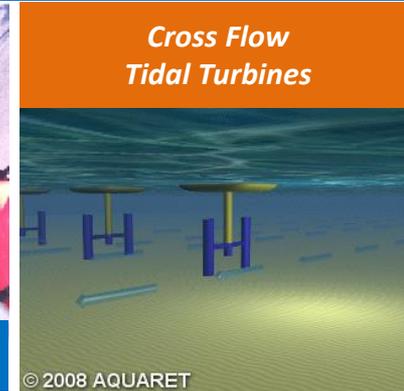
Collaboration Partner:

THE EUROPEAN MARINE ENERGY CENTRE LTD

NANYANG TECHNOLOGICAL UNIVERSITY



- **Tidal Turbine Device Research**
  - Novel Aero/hydrofoil shape & Rotor design
  - Light weight fatigue-resistant material research
  - Multi-functional coating research
- **Support Structure Research**
  - Turbine Wake Field Studies
  - Fluid-structure interaction research for Mooring / Supporting Structure
- **Research Against Environmental Impact**
  - Effects on Marine Ecosystem
  - Seaweed / Debris Effect on Propeller Rotor
  - Anti Bio Fouling and Marine Corrosion coating
  - Underwater Acoustic noise
- **Battery Storage & Grid integration studies**
  - Distributed grid System Integration
  - Alternative transmission for maritime usage
  - Energy storage system research for charging Electric boats, power supply to harbour
  - Fuel cell for ferry boats



We are working with **global partners** and the **Singapore Maritime Industry** to build our R&D center for **Smart and Green** maritime research.

## ClassNK & Global Partners



Technische Universität München



## Singapore Maritime Industry



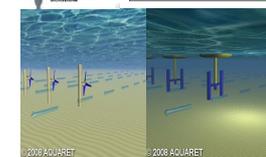
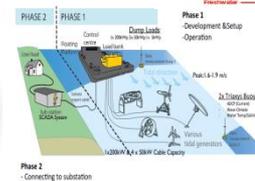
Institute of High Performance Computing



semcorp marine

Keppel Offshore & Marine

## Projects in Singapore





Thank you very much!