Asia and the Pacific Transport Forum 2024
ADB-Japan Sustainable Transport Technology for the Future

Decarbonization of the Cargo Handling Equipment at Port

May 17th, 2024 @ADB-HQ Manila, Philippines

MITSUI E&S

MITSUI E&S Co., Ltd.
New Business Development Div.
Marketing Dept.
Kinya ICHIMURA, P.E. /Head of Marketing Gr

Today’s Topics

1. About MITSUI E&S
2. About Container Terminal and RTG
3. Development of FC powered TRANSTAINER®
4. For the Future Zero-Emission of CT

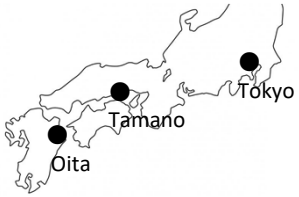
1. About MITSUI E&S

1.1. About MITSUI E&S

1917 MITSUI ENGINEERING & SHIPBUILDING CO.,LTD. → 2018 MITSUI E&S Mitsui E&S Machinery Co., Ltd. Subsidiary of Mitsui E&S Holdings → 2023 MITSUI E&S

↑Headquarters, Tokyo

↑Tamano Works



Oita works→

Marine Propulsion Systems

Industrial Machineries

Cranes & Systems

After Services

- New Business Development Div.
- Marine Propulsion Systems Div.
- Logistics Systems Div.

- Mitsui E&S Systems Research Inc.
- KAJI TECHNOLOGY CORPORATION.
- Burmeister & Wain Scandinavian Contractor A/S
- PACECO CORP.
- Mitsui E&S Power Systems Inc.

The other subsidiaries

Net Sales; 262,300 million Yen (2022FY)
Employees; 5,747(As of March 31, 2023)
(Consolidated)

1.2. Decarbonization Products by Hydrogen

Marine Propulsion Systems Div.

Large size 2-Stroke
Hydrogen Combustion
Marine Engine

New Business Development Div.

High-Pressure
High-Flow
Hydrogen Compressor

Logistics Systems Div.

Hydrogen Fuel Cell
Powered
Rubber Tier Gantry Crane

2. About Container Terminal (CT) and Rubber Tired Gantry (RTG) Crane

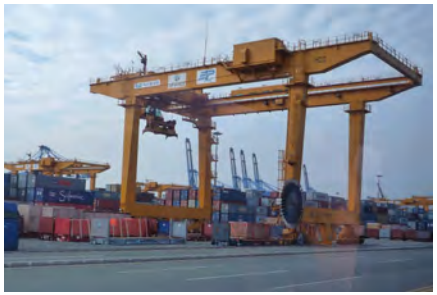
2.1. About the Container Terminal

Recently, much of the international cargo logistics relies on ocean container transportation, and container terminals (CTs) are storing the cargos temporarily until they are loaded onto a container vessel, or until a shipper can pick them up after unloading from a container vessel.

Stacking Yard Cranes in the CT

Automated Stacking Crane(ASC)

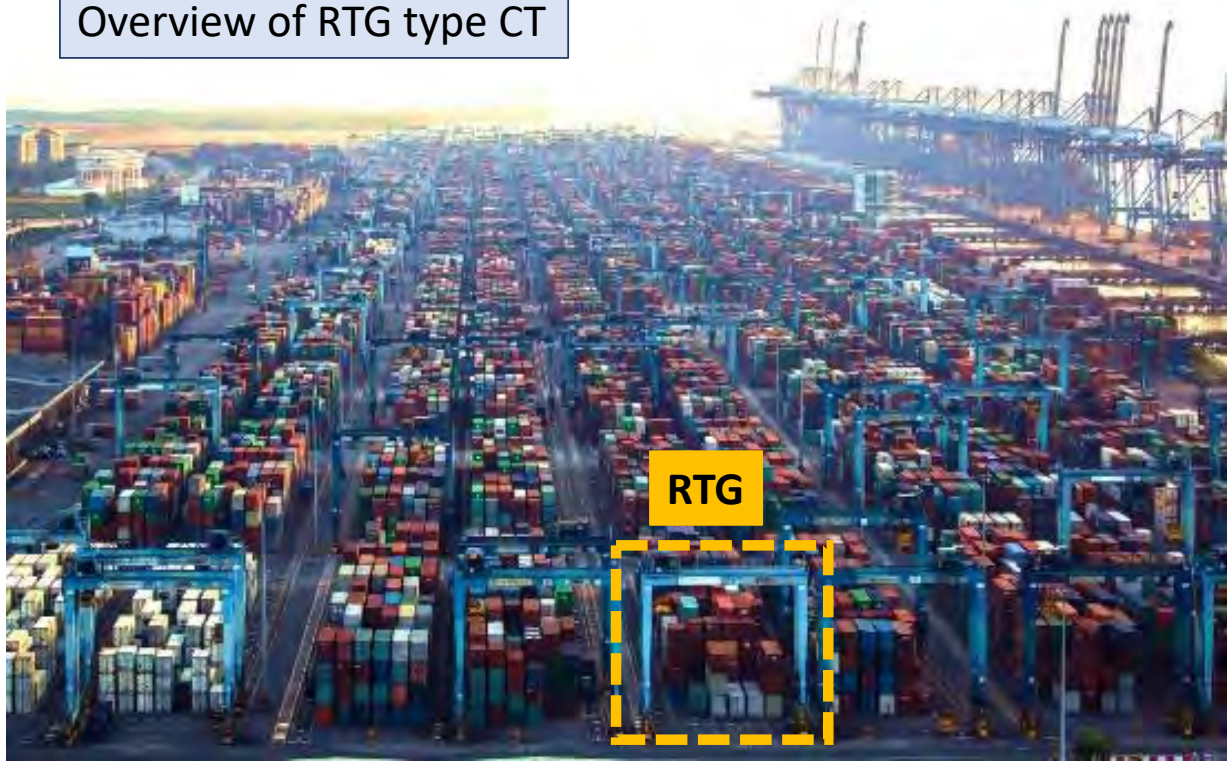
Rubber Tired Gantry Crane (RTG)



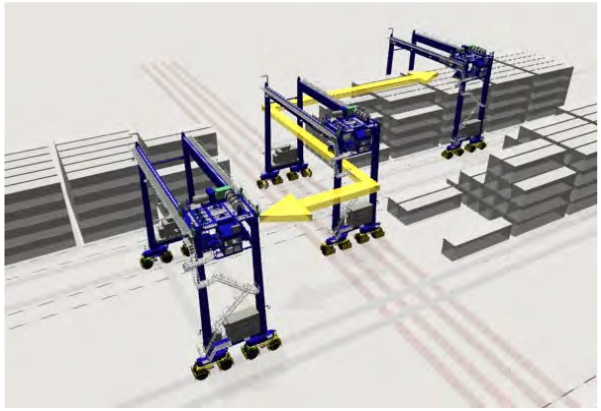
Rail Mounted Gantry Crane (RMG)

Straddle Carrier (SC)

Overview of RTG type CT

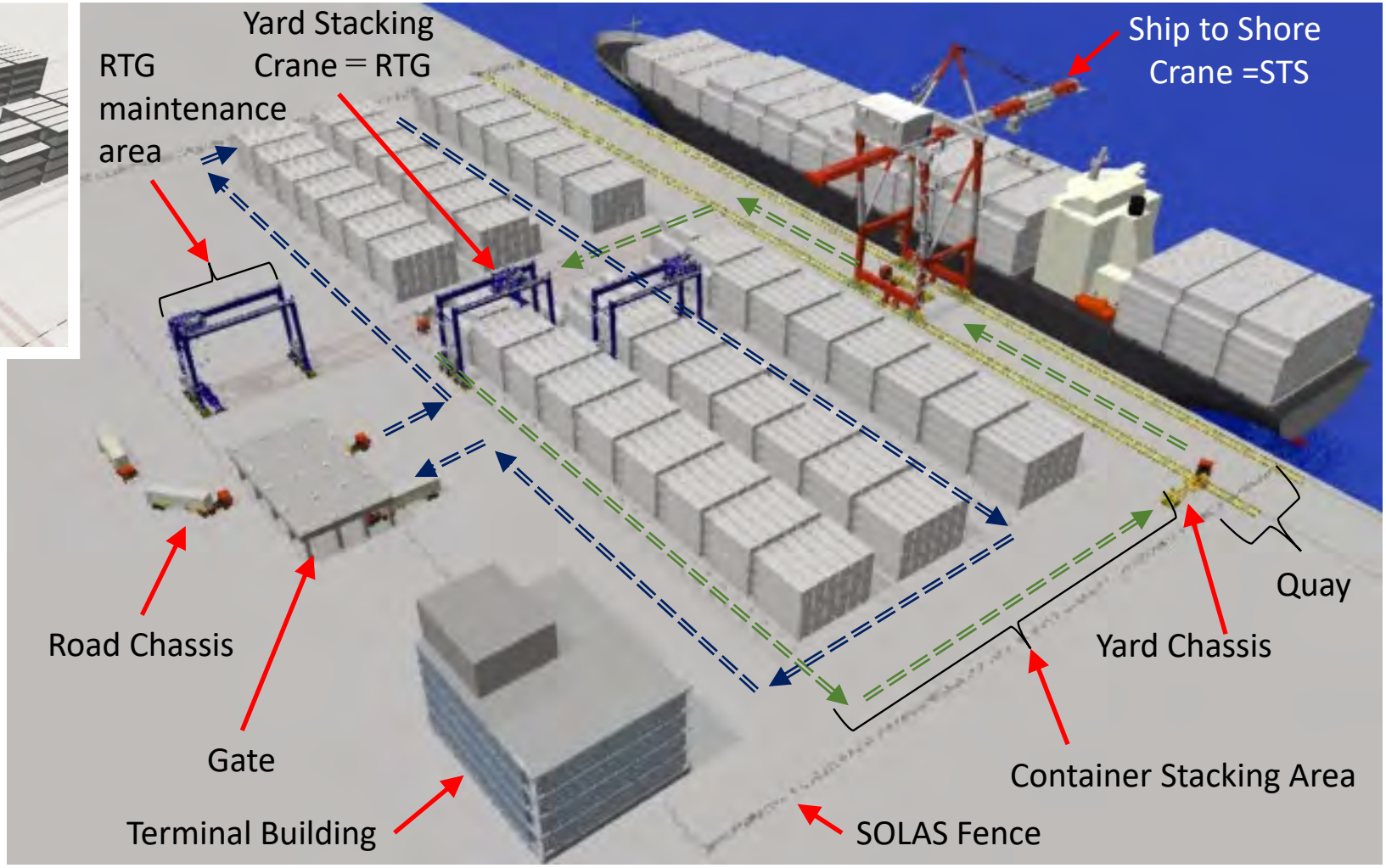


2.2. Layout of typical RTG Container Terminal



RTGs are highly maneuverable due to equipped with rubber tire gantry machinery and can be deployed in the necessary stacking area depending on the busyness of operation. It making it possible to operate CT efficiently with fewer units.

Advantage of RTG



2.3. The Conventional RTG Cranes

- Since PACECO® Inc. delivered the first TRANSTAINER® RTG crane, onboard Diesel Generator has been equipped as a power source for RTG to drive electrical motors.
- According to the report of CAAP, RTG crane consume 9.5 gallons (abt. 36L) of diesel fuels in one hour ※.

※ in MES experience, consumption of RTG is much better than this data.

RTG in 1950s

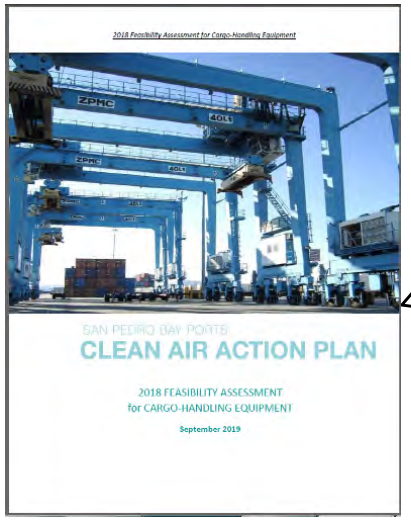


Table 20. Fuel consumption and useful life estimates

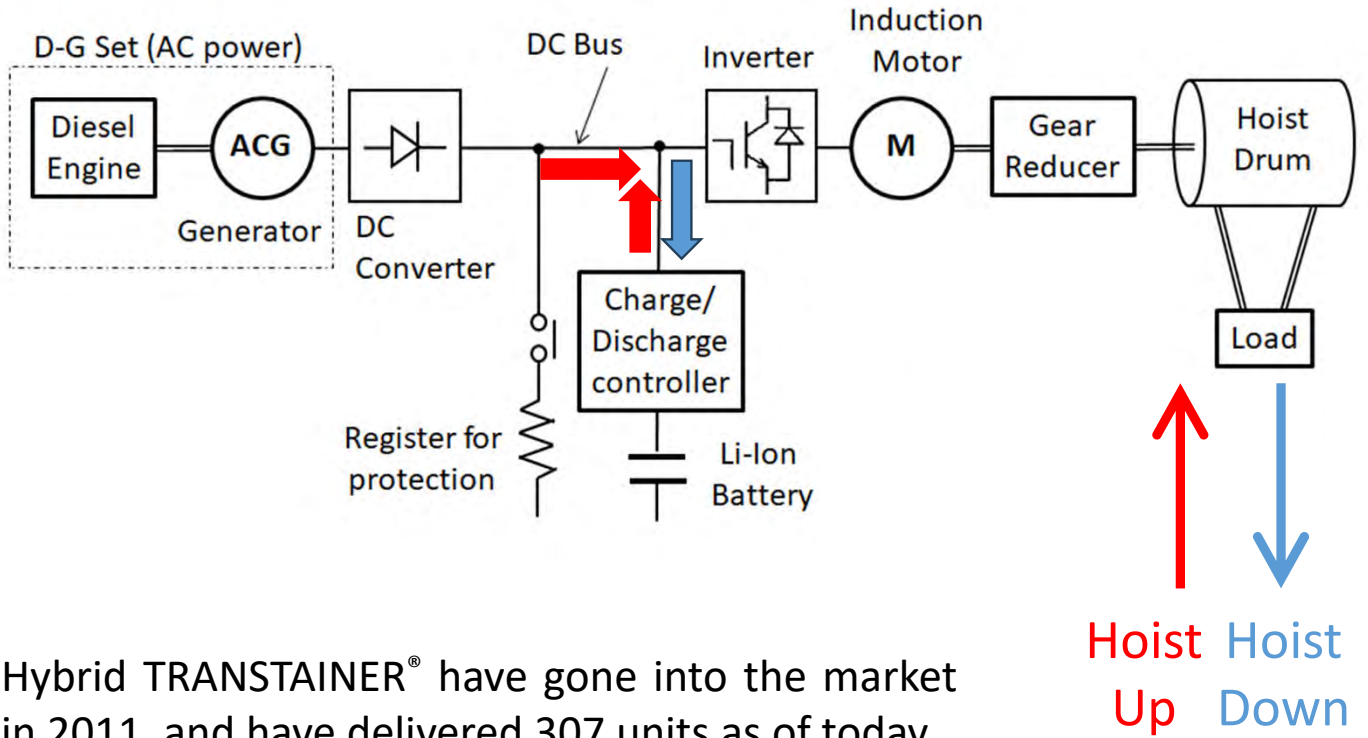
Equipment Type	Fuel Consumption	Useful Life
Conventional RTG Cranes	9.5 gallons/hour	15-25 years
Hybrid RTG Cranes	5.5 gallons/hour	15-25 years

2018 FEASIBILITY ASSESSMENT for CHE (Sep. '19)

9.5 gallons(abt. 36L)/hour diesel fuel is equivalent to **92.8Kg-CO2/hour** emission

2.4. Hybrid System on RTG

The RTG crane stores re-generated energy during hoist-down that electrical motor generate, in the power storage device (Li-ion battery etc.), and reuse during hoist-up.



Hybrid TRANSTAINER® have gone into the market in 2011, and have delivered 307 units as of today.

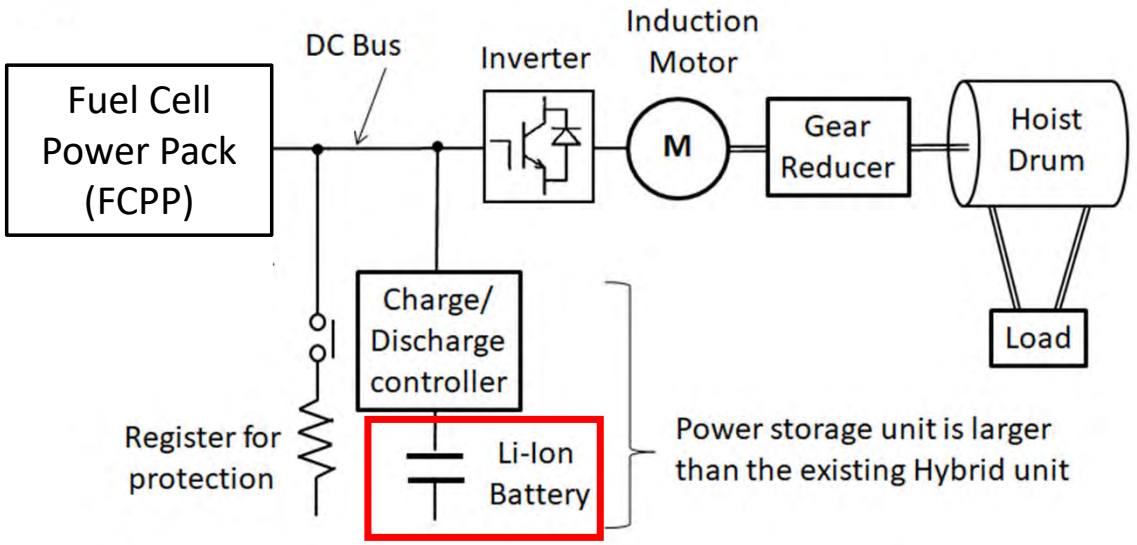
3. Development of FC Powered TRANSTAINER®

The develop projects for FC powered RTG crane are carried on under the support of the New Energy and Industrial Technology Development Organization (NEDO), Japan.

3.1. Design Difficulties of FC Powered TRANSTAINER®-1-

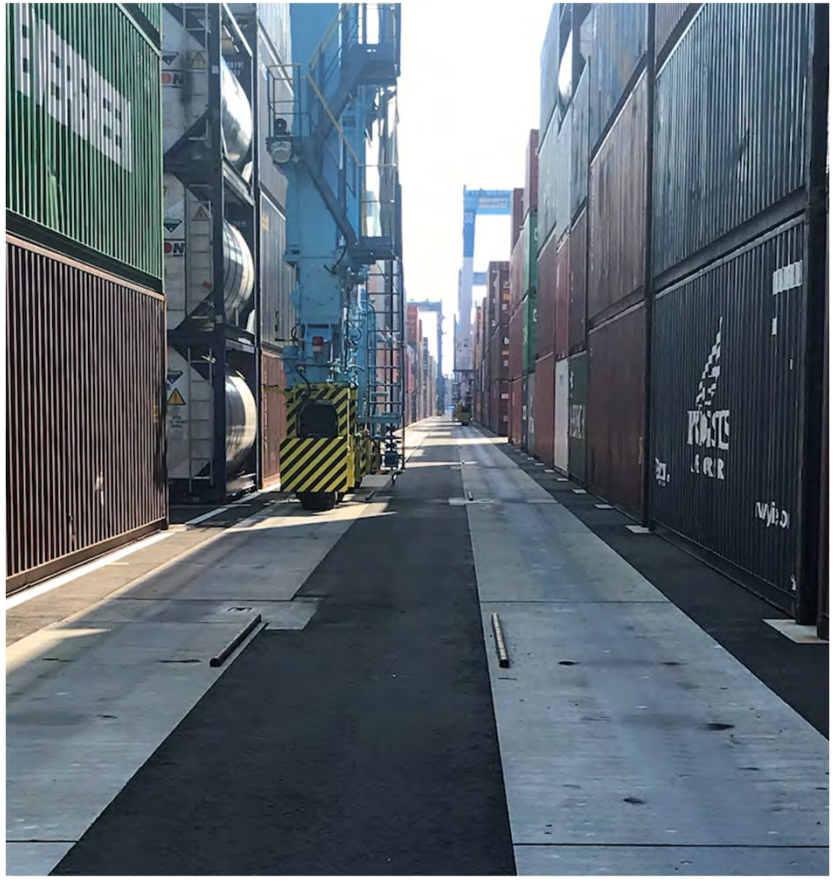
In RTG, regen power and handling load vary depending on the cargo weight, path & speed of handling etc.

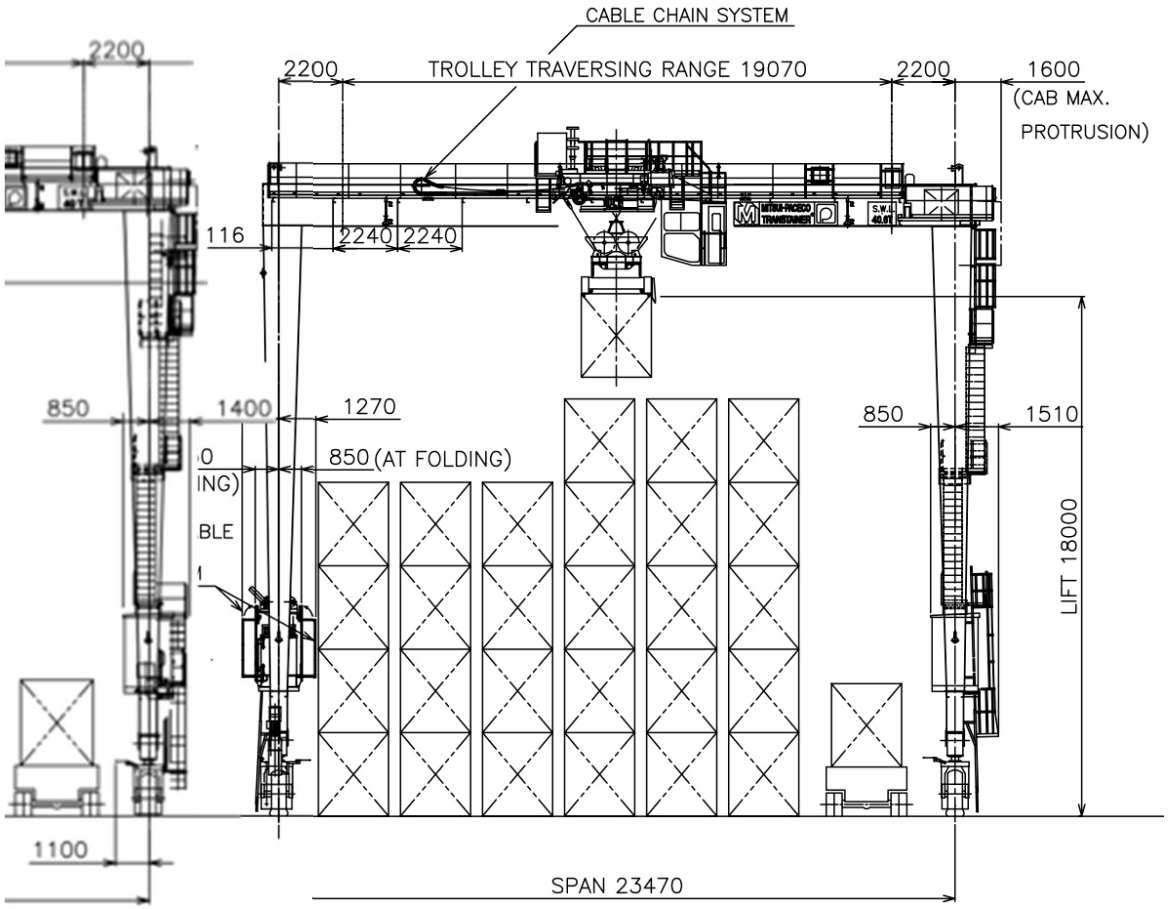
- Absorb load fluctuations adjusting the power output by large size batteries.
- High efficiency and long life span due to stable constant power operation of FC.



3.2. Design Difficulties of FC Powered TRANSTAINER®-2-

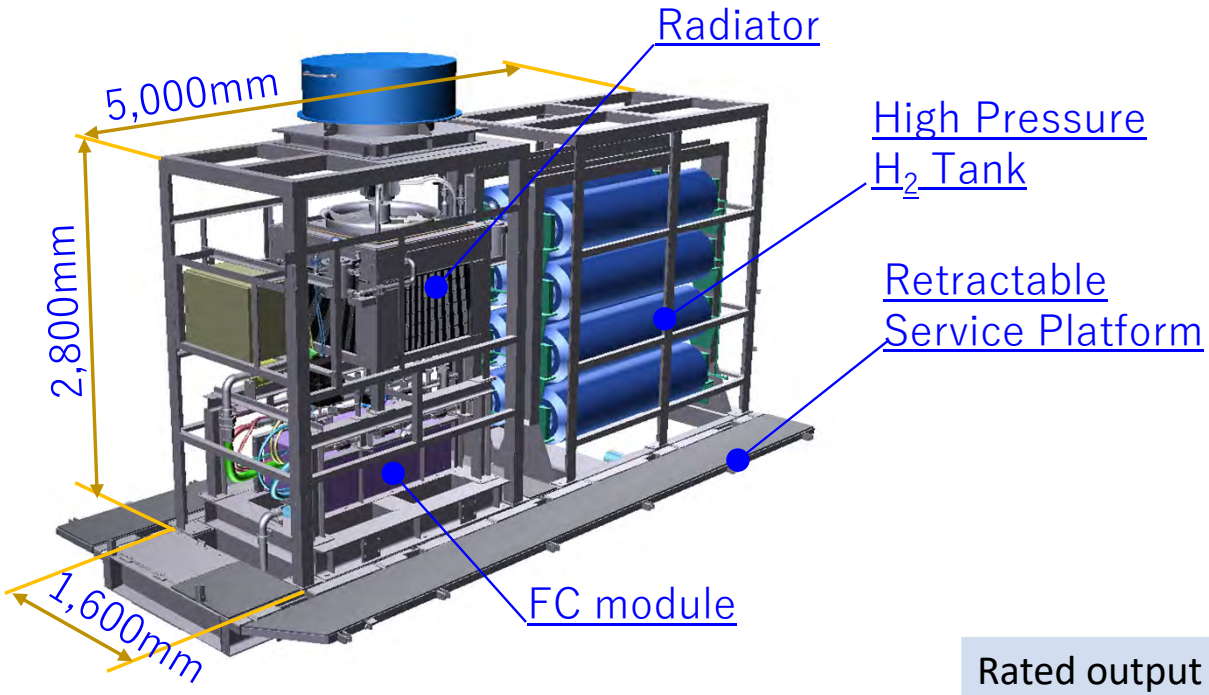
It is necessary to keep clearance within the limitation of RTG/RTG and RTG/stored containers.





Sample of dimensions for RTG

3.3. Enclosure of FCPP



Points of development
- Leveling of output fluctuations
- Installation in narrow spaces

Rated output FC module	60kW (DC 650V)
Pressure of H_2 Tank	70MPa
Capacity of H_2 Tank	64 kg-H_2
Hydrogen gas purity	ISO 14687-2: 201 (Type 1, Grade D)
Filling protocol	SAE J2601-1 , JPEC-S 0003

3.4. Hydrogen Supply and Filling during Oita trial

Hydrogen Manufacture (Saga)
Filling in to Cardle as 19.6MPa

(Oita)

Transportation of Cardle by truck

Cardle: A container assembled multiple cylinder vessels

Configuration:	50L × 30units	50L × 20units
Filling pressure:	19.6MPa	19.6MPa
Effective amount:	18.9kg	12.6kg (~2.0MPa)

H_2 storage & filling facility

Class 2 high pressure gas storage facility (cardle storage)

Class 2 high pressure gas Manufacturing facility

RTG FC Power Pack

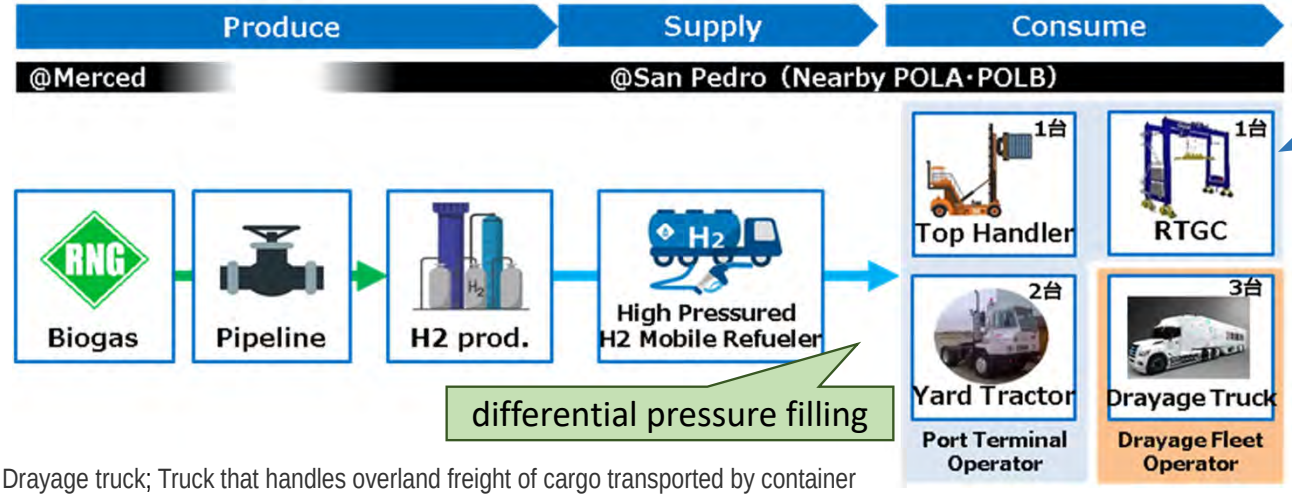
Hydrogen Filling

Differential pressure filling from 19.6MPa to high-pressure hydrogen tank on RTG via One-touch receptacle

3.5. Demonstration Project in LA

- Demonstrate the hydrogen supply chain from local production of clean hydrogen to the consumption point the port.
- Newly manufactured Hydrogen powered TRANSTAINER® will be delivered to a terminal in the Port of Los Angeles for testing in actual operation.
- Data during the actual operation including hydrogen supply and operating time will be collected and analyzed.

In collaboration with six companies:
- Toyota Tsusho Corporation
- Toyota Tsusho America Inc.
- Mitsui E&S Machinery Co. Ltd,
- PACECO CORP.



*1 Drayage truck; Truck that handles overland freight of cargo transported by container

4. For the Future Zero-Emission of CT

4.1. Upsizing of Hydrogen Compressor

- During the LA and Oita trial, high-pressure hydrogen is charged on-site by differential pressure.
- There are legal restrictions on public road transportation of high-pressure hydrogen.
- Some CT deploy hydrogen station with compressor inside the terminal.

For Conventional Hydrogen Station

Source; Kaji Technology Website

Capacity	340Nm^3/hr
Pressure	82MPa

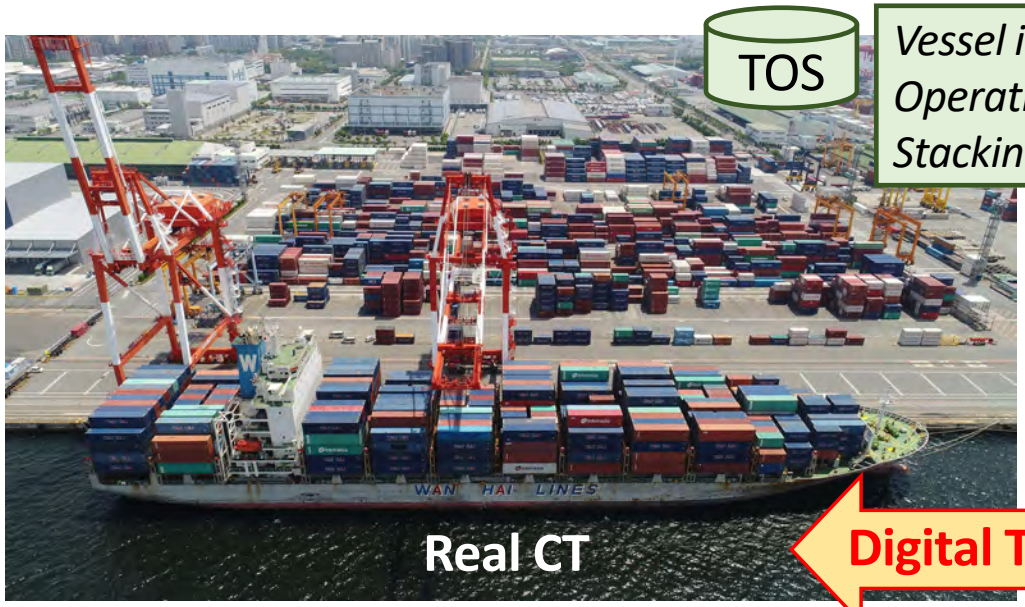
Upsizing of compressor is required

- RTG consumes approx. 70 kg/day of hydrogen※
- Large-scale CT operates more than 20 RTGs in one terminal

※ Depends on cargo handling situation and operating hours

Capacity	1,055Nm^3/hr
Pressure	50MPa

4.2. Digital Management of Refueling

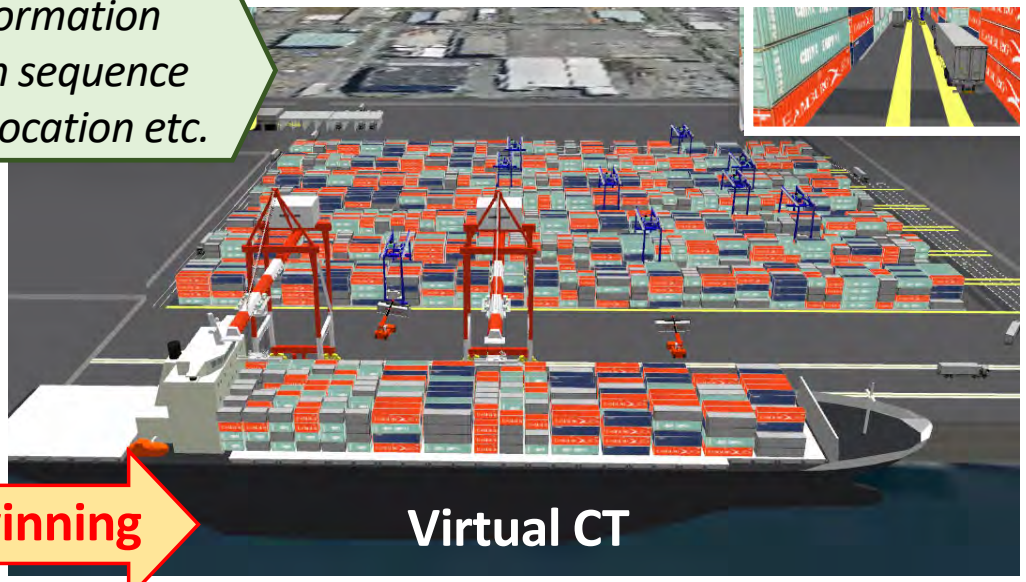


Real CT

TOS

Vessel information
Operation sequence
Stacking location etc.

Digital Twinning

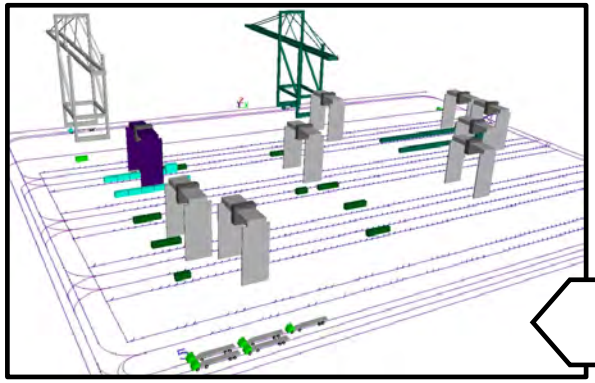


Virtual CT

- Make a refueling schedule
- Dispatch mobile refueler

Planner (Human)

Logistics simulator predicts the future situation in several cases.



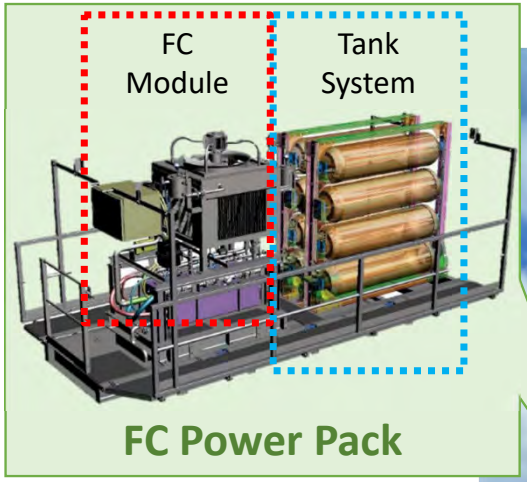
Data

AI

4.3. Bridge Solution to Zero Emission

NZE® TRANSTAINER®

Source; NYK Website



Battery

Control Panel

Small Size Diesel Generator

H_2-ZE® TRANSTAINER®

Convert to FCPP When hydrogen supply will be ready

Thank you for your attention.

MITSUI E&S Co., Ltd.
New Business Development Div.
Marketing Dept.,

Contact; kinya@mes.co.jp

https://www.mes.co.jp/english/