World Ocean Forum 2023 2023 제17회 세계해양포럼

Status and Prospect of Marine SMR Technology Development

2023. 10. ##

Korea Atomic Energy Research Institute

Senior Vice President

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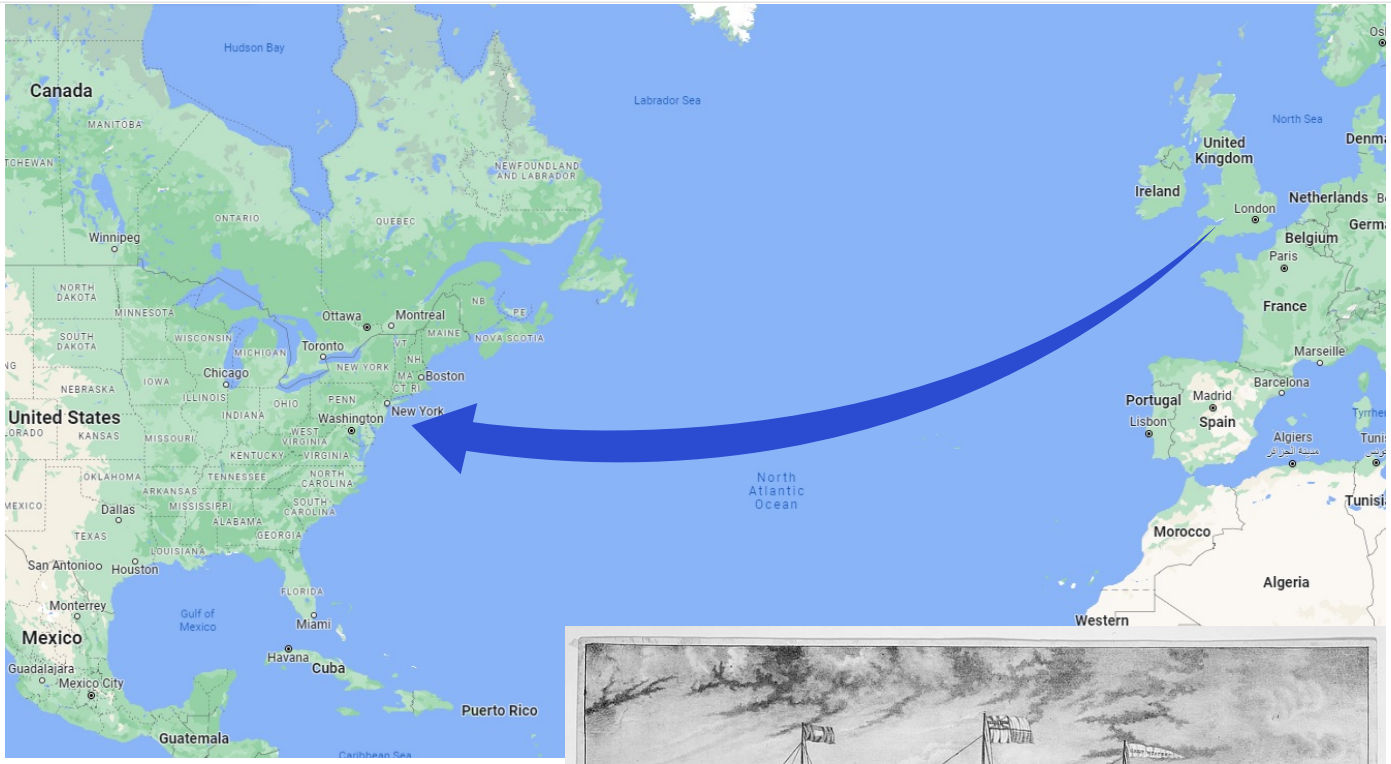
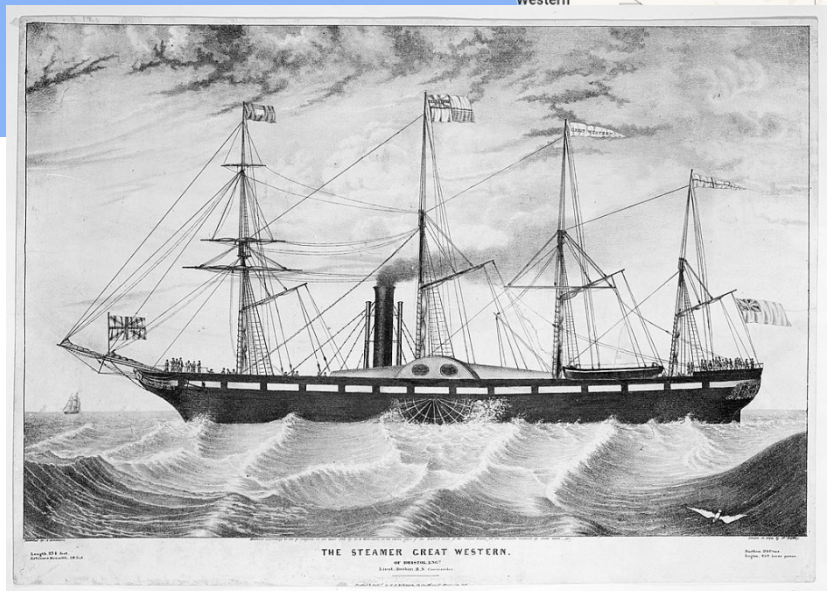
Long-Distance Trade Revolution

Q. Delivery on time?

- **The First Transatlantic Steamship, SS Great Western**
- **Sailing on April 8, 1838**
- Bristol, UK → New York, US
  (15 days)
- The steamship, along with the telegraph, revolutionized long-distance international trade





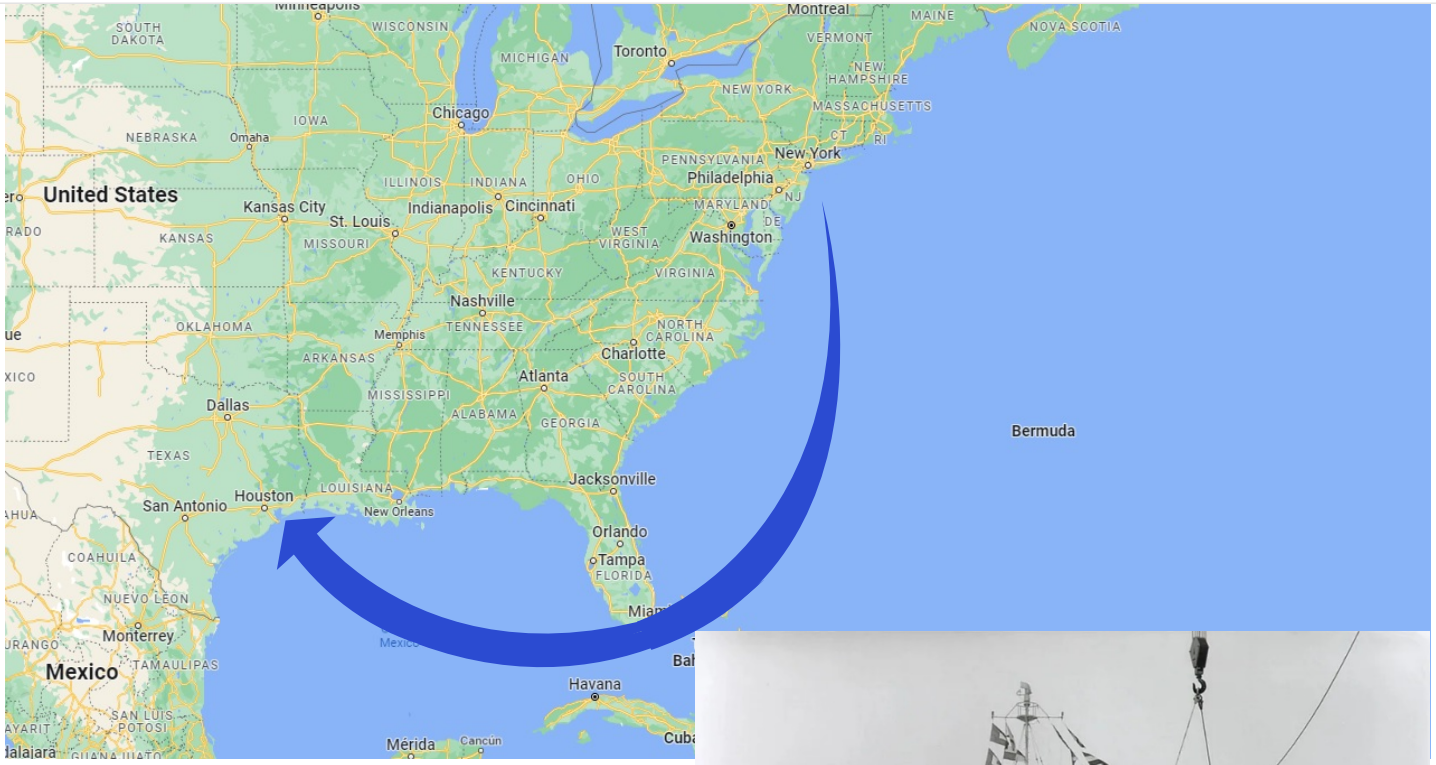
< SS Great Western >

[Ref.] Wikipedia

Transportation Revolution

Q. Reduce Cost and Time?

- **The Container Era, Ideal-X**
- **Sailing on April 26, 1956**
- Newark, New Jersey → Houston, Texas (5 days)
- Transportation of 58 aluminum containers
- Transportation Revolution → Globalization



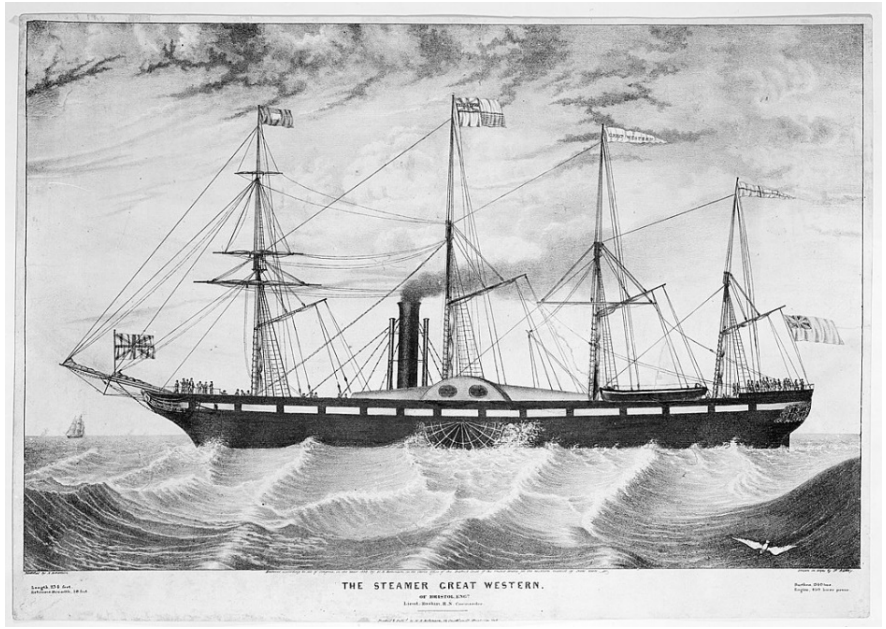
< Ideal-X >

[Ref.] The Geography of Transport Systems

A New Revolution in the Maritime Sector

A : Carbon Neutrality

- **Long-distance Trade Revolution**



< SS Great Western >

- **Transport Revolution**

< Ideal-X >

- **Green Revolution**

?

Current Environmental Issue in Maritime Sector

Q. Global Climate Change

- Sea Level 0.25 ~ 1.01 m ↑
- Seawater Temperature 1.4 ~ 3.7 ℃ ↑
- Ocean Acidification pH 8.1 → 7.65~8.05
- Potential Catch 20.5 ~ 24.1 % ↓
- Arctic Sea Ice 19~76 % ↓
  Antarctic sea ice 20~54 % ↓

Q. Maritime Sector

Emission (CO_2 eq.) :
1.076 Billion Tons
< 2018 >

Efforts for Mitigation

- ☞ **Slow Propulsion**
- ☞ **Using Low-carbon Fuel**
- ☞ **Follow Optimum Route**
- ☞ **Using Devices for Efficiency Improvement**

Revised GHG Strategy of IMO

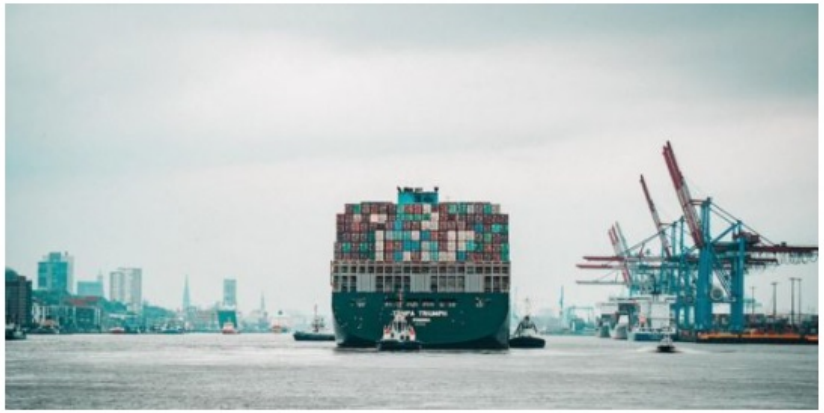
Q. Milestones for Net-Zero?

- **International Maritime Organization (IMO) : '2023 Greenhouse Gas Reduction Strategy'**
- ~2030 : minimum 20% (~30%)
- ~2040 : minimum 70% (~80%)
- ~ 2050 : net emissions '0' (Net-Zero)

IMO revise their GHG strategy in ambition to reach net zero GHG emissions from shipping by 2050

The Marine Environment Protection Committee (MEPC) saw member states of the International Maritime Organisation (IMO) agree to adopt the 2023 IMO strategy on the reduction of GHG emissions from ships, to mitigate harmful emissions. The revised IMO GHG Strategy focuses on ensuring uptake of alternative zero and near-zero GHG fuels by 2030, as well as indicative checkpoints for 2030 and 2040.

10 July 2023 | Press Release



[Ref.] Climate Action

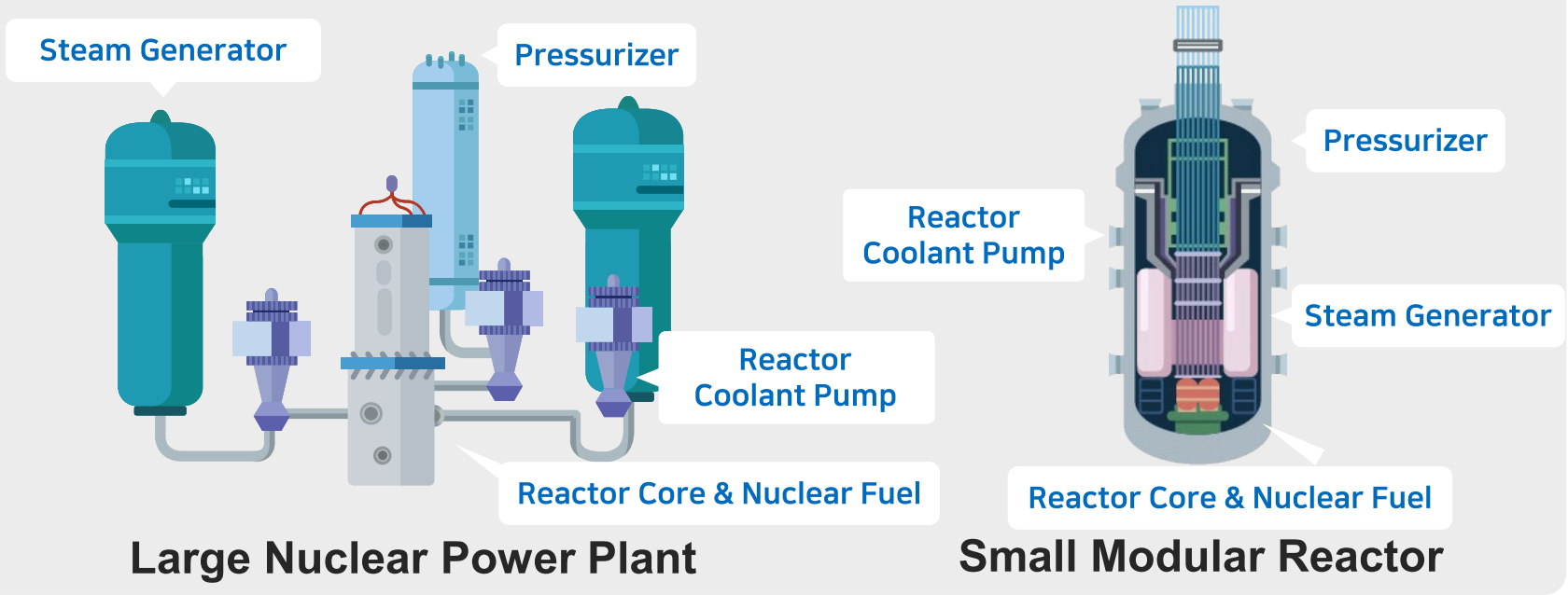
Nuclear Energy for Maritime Carbon Neutrality

A. Small Modular Reactor, SMR

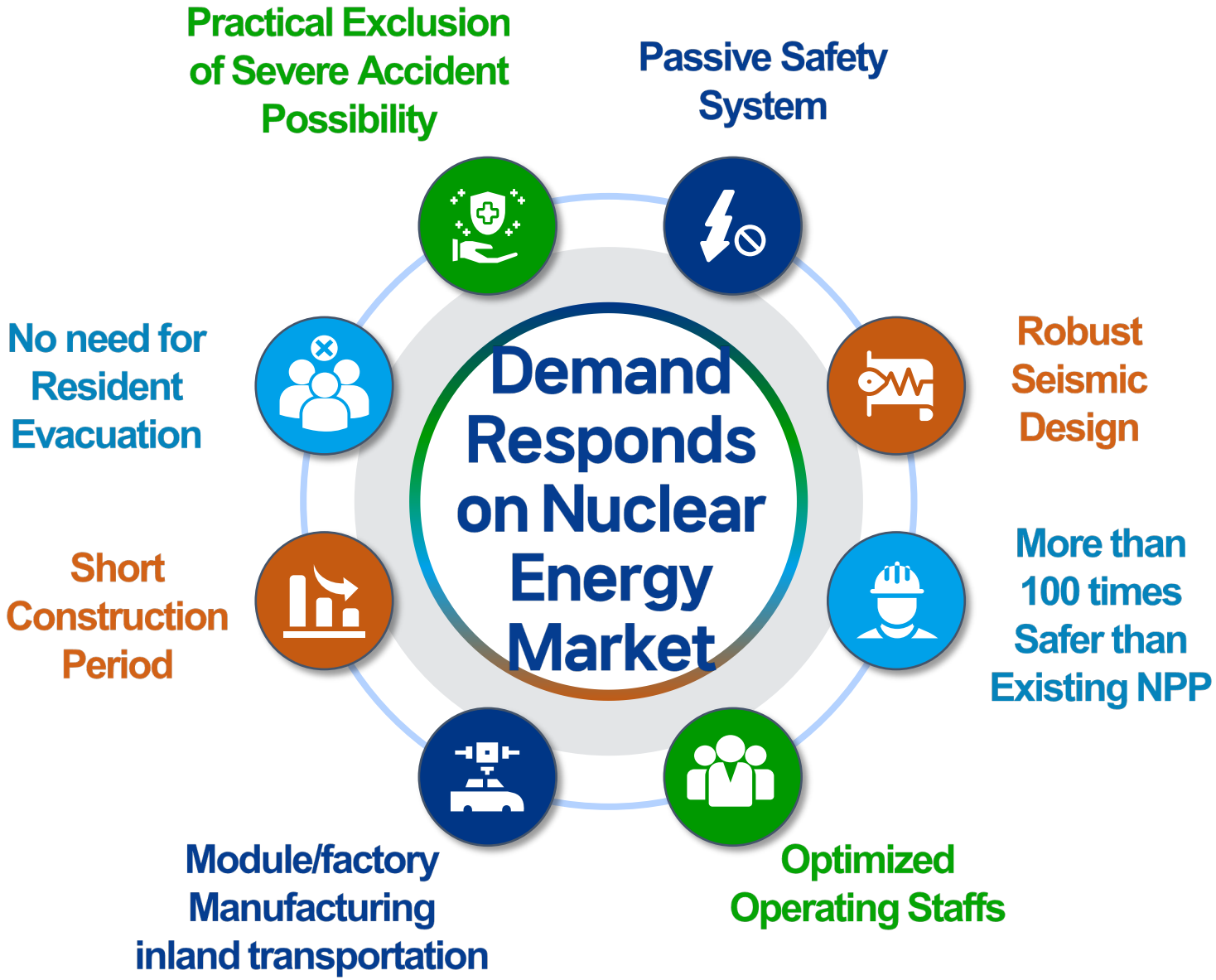
- **Nuclear propulsion → Powerful engines with no carbon emissions**

small + module

Electrical Output(MWe)	
Large	700 <
Medium	300 ~ 700
SMR Small	< 300



Advantages of Small Modular Reactor



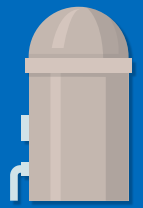
Requirements for Maritime SMR

No radioactive release and crew evacuation

Low construction and operating costs

Excellent inherent safety

Full modularization of equipment



Reducing spent fuel management

Passive safety to minimize operator mistakes

Status of Foreign Maritime SMR Development

In operation

< Russian nuclear-powered icebreaker, Arktika>

< Floating nuclear power plant, Akademik Lomonosov >

Under Development

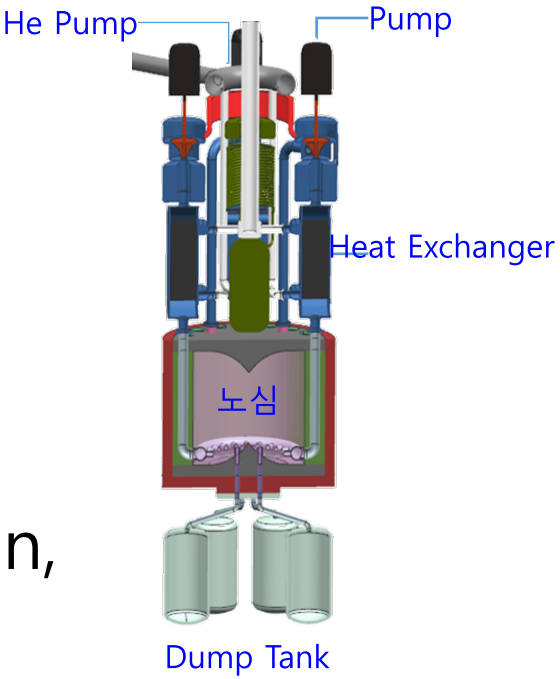
<Denmark Seaborg, CMSR>

< UK CorePower - US TerraPower, MCFR>

MSR - An Outstanding Candidate of Maritime SMR

A. Molten Salt Reactor – Gen. IV Reactor

- **Thermal output** : 100 MWth
- **Coolant** : Molten Salt
- **Outlet Temperature** : 650 ℃
- **Applications** : Ship Propulsion, Offshore Plant, Desalination, Hydrogen Production, etc.
- **Developer** : KAERI Korea Atomic Energy Research Institute, SAMSUNG HEAVY INDUSTRIES, HYUNDAI ENGINEERING & CONSTRUCTION, HD KOREA SHIPBUILDING & OFFSHORE ENGINEERING, Century, KRISO KOREA RESEARCH INSTITUTE OF SHIPS & OCEAN ENGINEERING

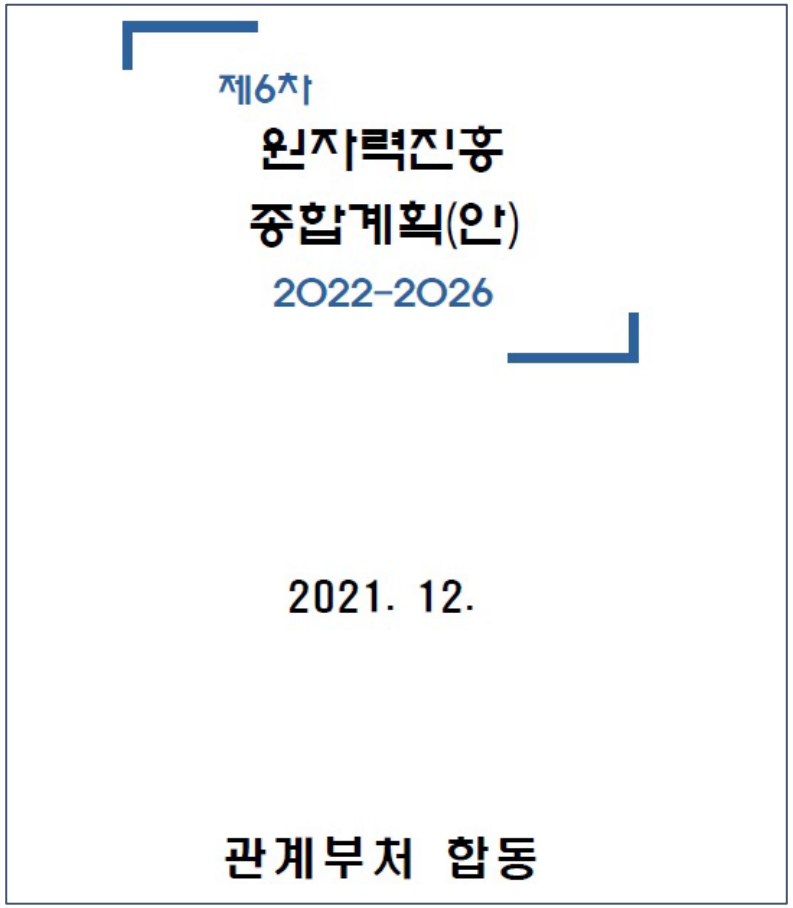


Government Policies Related to Nuclear Sector

The 6th Comprehensive Nuclear Energy Promotion Plan (‘22~’26)

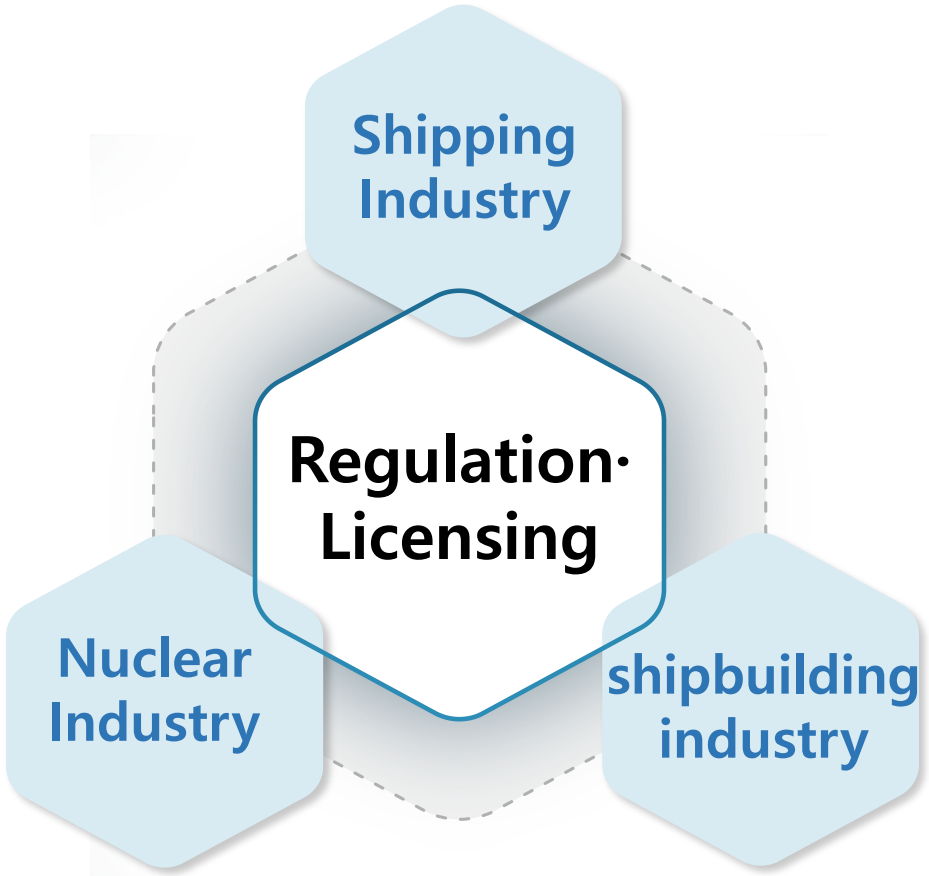
“Securing basic technology for **Molten Salt Reactor** suitable for mobile nuclear energy system and ship propulsion”

“Development of marine-nuclear interface technology ”



- Joint project between Ministry of Science and Technology-Ministry of Oceans and Fisheries, “Molten Salt Reactor Development Project“ launching (‘23~)

The Way Forward



"The 2050 Carbon Neutral Strategy in the international shipping sector is to change the framework of ships and fuels, and cannot be achieved with the efforts of the government or a few companies alone.

It is important for the government and the shipping, shipbuilding, and energy industries to cooperate closely together."

< Minister Cho Seung Hwan of Oceans and Fisheries, 2023.7.8 >

Thank You for Your Attention

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