2022
Polar Issue Report Infographic Book

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Ministry of Oceans and Fisheries

Korea Polar Research Institute

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Polar Science Infrastructure

Next-Gen IBRV Construction Plan and Its Future

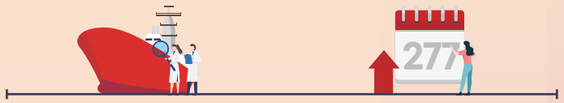
Next-Gen IBRV: Background

✓ Overcome of IBRV Araon's Limitations

1. With the icebreaking capacity(1m/3knots), it operates in the high seas of the Central Arctic Ocean **during summer season when the sea ice retreats to its minimum.**
2. It operates for **only 85 days** of research expeditions per year due to its Arctic to Antarctic journey and logistics support to the station.

The Necessity of Next-Gen IBRV

✓ Achievement of Operational Efficiency in Operation with IBRV Araon



Ensureing efficiency in polar research with the next-gen IBRV and IBRV Araon operating in the Arctic and Antarctic, respectively

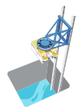
Increase the days of annual polar research expeditions from the current 85 days to 277 days through reducing the polar expedition

Perform Arctic research at higher latitudes by leveraging the new IBRV's stronger icebreaking capacity

Drive research expansion in the Arctic High Seas as well as research diversification and stimulation

Next-Gen IBRV: Major Features

✓ Enhance Research Performance with New Equipment and Improved Features



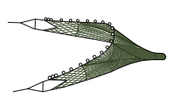
Moon Pool

Multibeam Echo Sounder

Giant Piston Corer

Remotely Operated Unmanned Underwater Vehicle

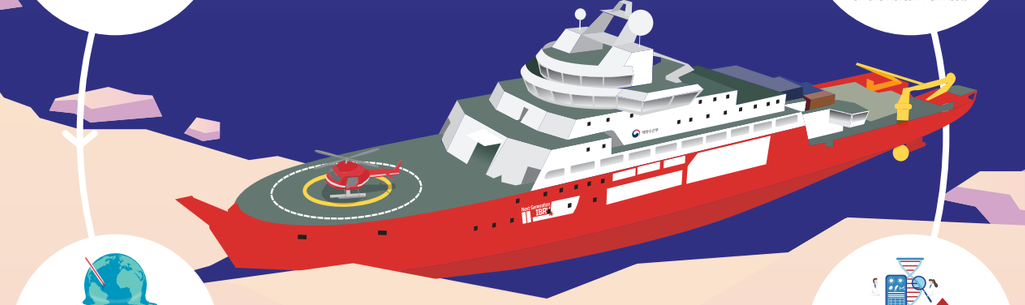
Wave Glider



Trawl System

Autosonde

Address the major 7 Polar Issues



- Increased needs for information-sharing and IT application for Arctic shipping route development
  Establish a marine transport system using Arctic shipping routes
- Arctic marine pollution and marine ecosystems conservation
  Build an ecosystem information system and analyze implications on the Korean Peninsula
- Loss of Arctic ice due to climate change and global warming
  Establish an independent sea-ice forecasting model
- Extreme weather events on the Korean Peninsula due to Arctic Environmental Change
  Take the Weather and Seasonal forecasting capacity to the global level
- CAOFA* coming into force andSecure Arctic marine resource quarters
  Contribute to building a fishing quota system through marine resources research
- Lack of Arctic resources data and lack of conditions for Arctic development
  Develop Arctic resources together with Arctic Countries and establish ISA** response strategies
- Growing expectations for Blue Bioeconomy in the Arctic
  Improve the Country's marine biotechnology capacity (to 90% of that of advanced countries)

*CAOFA: Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean

**ISA: International Seabed Authority

Objectives

✓ Build an eco-friendly IBRVs for Arctic research at higher latitudes

1. Secure world-class icebreaking capacity
2. Create a 'marine-station concepted' research environment
3. Promote co-use of IBRVs

Funding and Project Scale

✓ Approx. KRW 277.4 billion in total project budget
✓ Reinforced performance and safety

Icebreaking capacity (Cold-resistance performance)	Improved space-efficiency
Continuous icebreaking (−45˚C) at **3 knots speed** in 1.5m thick level ice	**Detachable Mode (Module type)** Establishment of lab-units for optimal space configuration

Vessel size	Range / Endurance day
 **140.8mx25mx13m / 15,450 tons** (L x B x D / Gross Tonnage)	 **20,000** nautical miles /  **Over 75 days**

Capacity of Passengers	Others
 **100** Crew: 34 Research staff: 66	Greater research safety **with Moon Pool *** and eco-friendly LNG fuel

*Moon Pool: A large opening, located in the hull of a vessel, widely adopted by new icebreaking research vessels built in Germany, Norway, China, U.K., etc., to ensure research equipment safety in melting ice water

Construction Plan

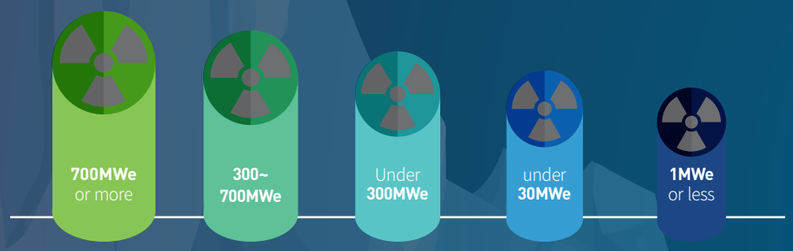
- Concept and basic design (- Dec. 2023)
- Construction (- Jul. 2025)
- Launching and delivery (- Jun. 2026)
- General test cruise (- Oct. 2026)
- First voyage (- Jan. 2027)

Development of Multipurpose Micro Nuclear Propulsion Technology and **Its Applicability to Polar Regions**

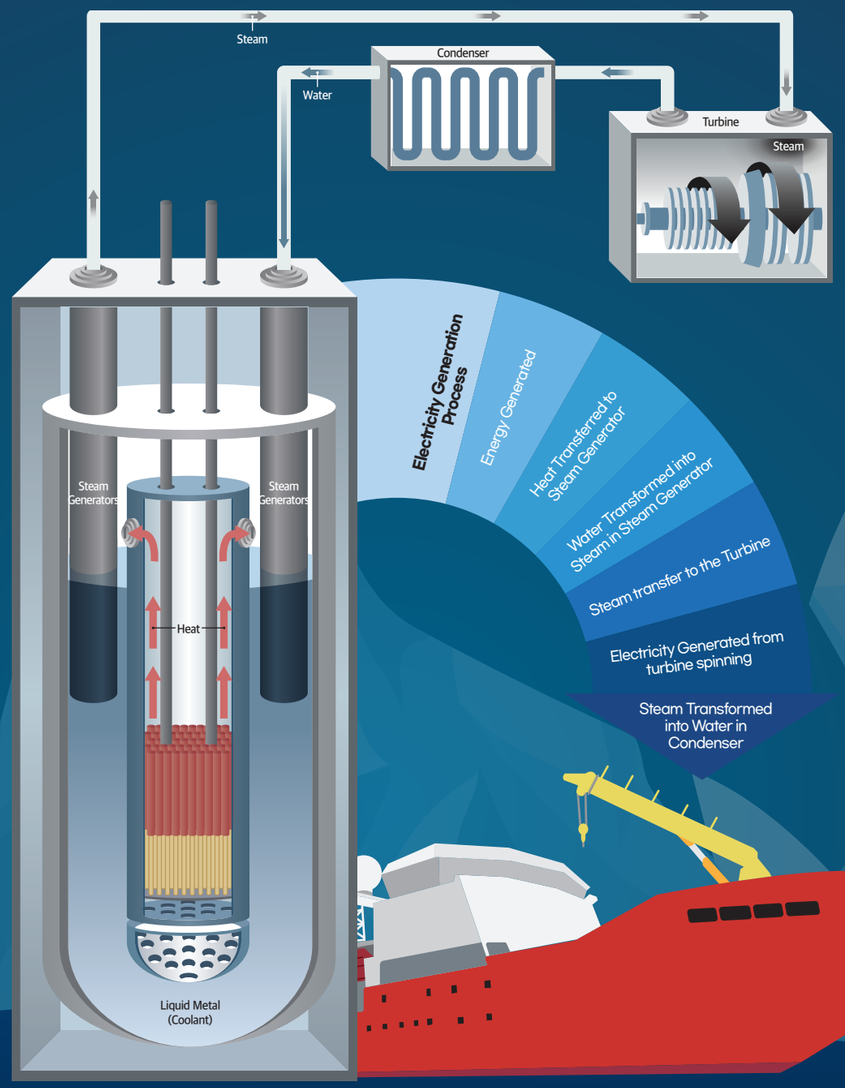
Smaller, advanced **next-gen nuclear microreactor on the rise**

Small modular reactor (SMR) technologies are newly emerging for a single microreactor smaller in size than the conventional one yet built with the existing critical features

Nuclear reactor categories by power output



Small nuclear reactors are called the **'Ideal nuclear reactor' or 'Generation IV nuclear reactor'** because they are safer, more efficient in power generation than conventional large nuclear plants.



Apply multi-purpose Microreactor Technologies in polar activities

Expanding the Use of the New Arctic sea routes and development opportunities as global warming melts Arctic see-ice

- Stable power supply essential to polar research under the harsh environments

Growing need for green, smart, nuclear propulsion technology in shipbuilding

- Vessels can be propelled by a 30MW or less microreactor, one-hundredth the size of conventional large nuclear reactors.
- Large nuclear-powered commercial vessels are expected to be employed more to sail the Arctic sea route.

Convergence of Advanced Future Shipbuilding Technology and **SMR Technology**

Develop the microreactor propulsion through the leverage of two leading technologies

SMR Propulsion Vessels

1. Used in icebreaking, resources exploration, power supply, desalination, and hydrogen and ammonia generation
2. Longer endurance for polar expeditions and decentralized power supply
3. Growing global interest in various SMR concept development and SMR application in marine & polar areas
4. Reduced shipping costs (labor, fuel, etc.)

Automated Sailing Technology

AI, Big Data, 5G, interdisciplinary and convergent ICT technology, etc.

- ✓ Unmanned, automated sailing enabling operation in extreme conditions and reducing human error
- ✓ Greater space and efficient structural arrangement improving economic benefit
- ✓ Combination of AI, Big Data, and 5G technology placing the country in marine and nuclear leadership

Safe and Economical **Small Modular Nuclear Reactors in Use**

76 companies in 18 countries are currently developing SMRs for different types, and 10 of them are targeting for marine propulsion.

South Korea
Since January 2021, Korea Hydro & Nuclear Power and Korea Atomic Energy Research Institute have invested KRW 50 billion in developing an innovative SMR (i-SMR).

U.S.
NuScale Company has developed an SMR for land-based power generation. The reactor is the first SMR design certified by the U.S. Nuclear Regulatory Commission.

Russia
Russia developed the country's first floating nuclear plant Akademik Lomonosov, which is now in operation in Pevek, a Russian Arctic Sea port, since 2021.

Prospects for Marine SMR Propulsion **Technology Development**

Tasks to pursue under the goal of becoming the world's leading marine country through development in polar regions

Restoring Trust
Restore trust in nuclear energy in terms of nuclear safety concerns, nuclear emergency preparedness, the environmental impact of nuclear power, and nuclear non-proliferation

Building Infrastructure
Build infrastructure for international cooperation to nurture related interdisciplinary capabilities and address SMR regulation issues

Preoccupation in Technology development
Gain competitive advantages in shipbuilding and interdisciplinary nuclear technology to overcome extreme polar conditions

Policy-making
Set the policies for consistent industry-academia-research polar and SMR projects led by the government

Policy-Directions and Challenges

STEP 1

Strengthen national strategy and international cooperation to gain technological competitivenessin development of microreactor propulsion

STEP 2

Build **a stepping stone** to advance to the **polar industry** and **enhance** the national **status** as a marine leadership country in the world

UNCLOS
Its 40th Anniversary and Polar Regions

UNCLOS

(United Nations Convention on the Law of the Sea)

An agreement adopted in Montego Bay, Jamaica, on December 10, 1982, after discussion between developed countries wanting to maintain their vested interests in the oceans and developing countries insisting that the ocean is a common heritage of humanity

Can UNCLOS be a viable response to marine ecosystems under the threat of rapid climate change?

UNCLOS and **Climate Change**

Is UNCLOS sufficient to address marine issues emerging as a result of climate change? YES

- UNCLOS plays a key role in addressing the effects of rising sea levels, global warming, and ocean acidification.
- According to the definition of "pollution of the marine environment" set forth in Article 1 of UNCLOS, climate change can be explicitly associated with ocean pollution.
- However, it is important for sovereignty-centered UNCLOS to achieve harmony with other related frameworks in the area of climate change response where non-state actors* play an important role.

*Non-state actors: NGOs, international organizations, etc.

Can UNCLOS Part XV (Settlement of Disputes) resolve climate change issues? YES

- The International Court or Tribunal for the Law of the Sea have jurisdiction over all climate change disputes. Non-compliance with UNCLOS can be raised in light of the Paris Agreement.
- This is pursuant to the interpretation of UNCLOS Part XII, and all parties may file a claim.
- When a state files a claim for non-compliance with the obligations under UNCLOS, UNCLOS Part XV may provide an enforcement mechanism.

South Korea's Response Plan in the Arctic

As an observer admitted to the Arctic Council in 2013, we should identify our rights and obligations within the framework of various multilateral treaties in effect.

Research should be done on the Artic Council and other related frameworks and mechanisms, and cooperation with coastal states is essential to our entry into the Arctic.

Policy Implications

1

If polar issues are seen as marine issues, it will be difficult to rule out the application of UNCLOS to polar issues with sovereign states involved.

2

The application of UNCLOSis limited in the Antarctic due to the Antarctic Treaty that restricts the exercise of jurisdiction. In the Arctic that recognizes Artic States' sovereignty rights, UNCLOS is more likely to play a more direct role.

3

To treat polar issues as maritime issuesfrom the perspective of a sovereign state, more complementary legal frameworks need to be built around UNCLOS.

4

There is no platform to seek harmony between UNCLOS and the United Nations Framework Convention on Climate Change. Such a platform needs to be established for climate change issues because the role of non-state actors in these issues is important.

UNCLOS, as a constitution for polar maritime affairs, should **seek ways to maintain its status** through harmony with other systems.

UNCLOS and **the Arctic**

Growing Voice for a New Legal Framework

"States should abandon UNCLOS and implement a new legal framework."

VS

Support for the Existing Framework

01 If UNCLOS is abandoned, it will weaken the current Arctic conditions largely dependent on legal systems and trigger economic uncertainties and potential security issues.

02 Formalizing, adopting, and implementing a new Arctic law will be quite challenging.

03 A comprehensive framework, such as the Antarctic Treaty, is not appropriate for the Arctic.

04 UNCLOSexplicitly sets forth the rights and obligations required for Arctic governance.

UNCLOS and **the Antarctic**

UNCLOS

A global convention that applies to the world's oceans and seas, including the Antarctic
(However, no explicit provisions on the Antarctic)

UNCLOS is not exclusive of all of the other international conventions.

Antarctic Treaty

Just as UNCLOS protects the deep sea, it seeks to protect ecosystems outside of state sovereignty as much as possible.

It only applies to the Antarctic region and restricts the exercise of activities under it.

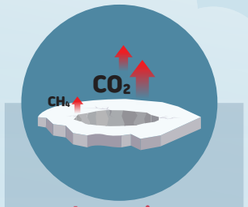
If UNCLOS and the Antarctic Treaty supplement each other, most Antarctic affairs will be covered by them.

Arctic Ecosystems are Changing

Global Warming Melting Glaciers and Sea Ice

Environmental Destruction and Global Warming Creating a Vicious Circle

Rising Arctic summer temperatures due to extreme climate events



Increasing greenhouse gas emissions

Greenhouse gas emissions from sinks created inthawing permafrost

Shrinking freshwatersupplies in rivers and lakes and accelerating climate change

Disappearing glaciers

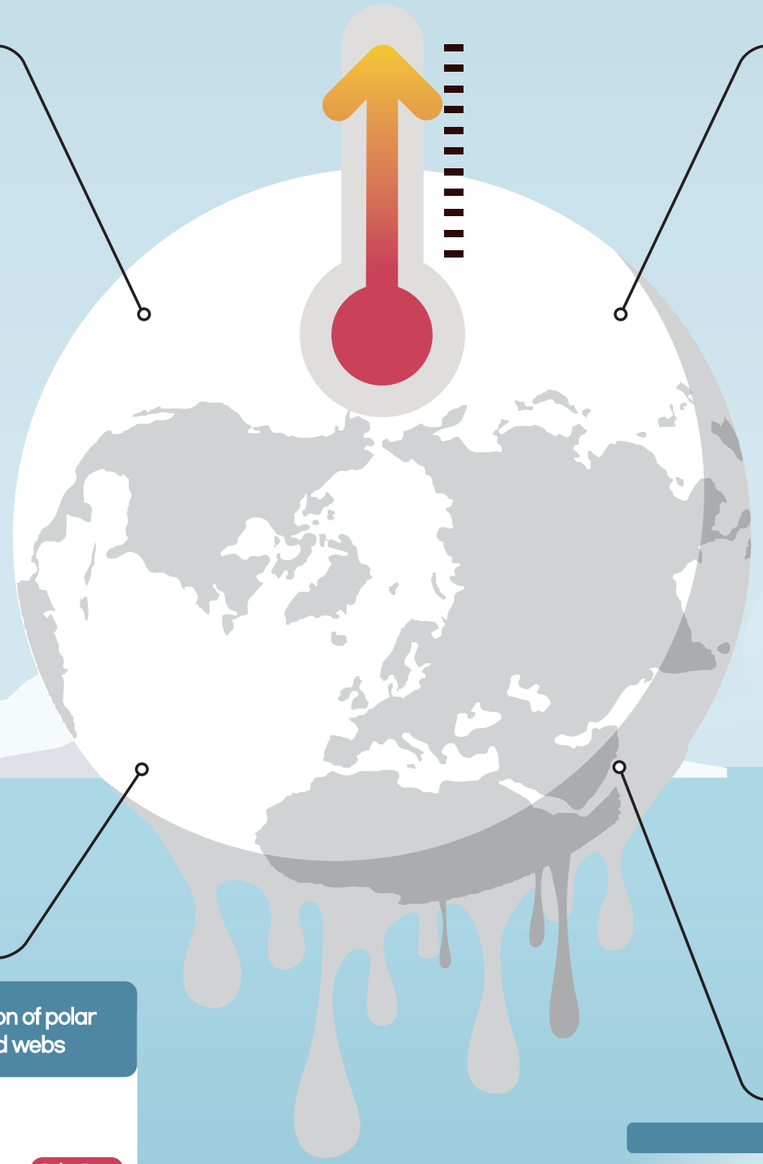
A 5°C increase in temperaturewill lead to the ultimate destruction of glaciers in the Arctic and Antarctic and the rise of sea levels.

Coastal citieswill be underwaterand incoming water will flood far inland areas.

Reduced reflectivity of solar radiation

Rising temperaturesturning algae in polar regions from green to scarletcausing "snow blood"

Reduced reflectivityof solar radiationincreasing the average temperature on Earth

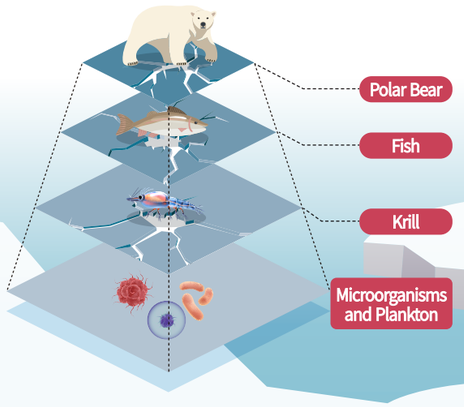


Impact of Global Warming on Polar Ecosystems

Shrinking polar cryosphere and retreating glaciers destroying the habitats of species that depend on the ice for survival

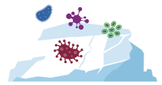
1. Species extinction, changes in biological communities, shifts in food resources, intrusion of alien species, changes in dominant species, etc.
2. Accelerating glacier melting due to growing vegetation left by melting ice

Changing structure and function of polar ecosystems destroying food webs



Increasing Risk of Globally Spreading Infectious Diseases

Reported Cases

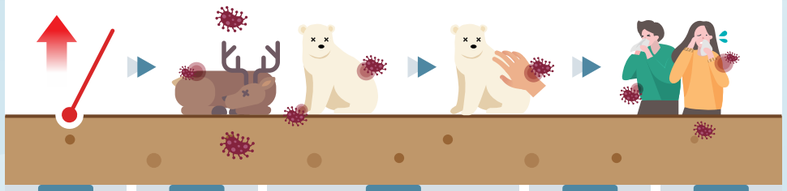


28 new viruses discovered surviving inside glaciers in Tibet (2020)

Reindeer herds killed by thawed anthrax due to melting permafrostin Siberia

A Russian nomadkilled after direct contact with the carcass of a reindeer killed by anthrax(2016)

Concerns on the Outbreak of Zoonotic Diseases



01	02	03	04	05
Pathogens released by thawing permafrostdue to rising temperatures	Blurring habitat boundaries between polar animals and animals in the temperate zone due to climate change	Animals in the temperate zoneinfected with pathogens released from the melting polar regions ↔ Polar animals infected with pathogens coming from the temperate zone	Humans infectedafter direct contact with the animals	Accelerating spread of infectious diseases due to globalization, etc.

Climate change is not a future threat,
but **a reality that affects human health.**

Response Measures to Safeguard Planetary and Human Health

Overseas

- CAFF, the biodiversity working group for the conservation of Arctic flora and fauna of the Arctic Council, established the Circumpolar Biodiversity Monitoring Program (CBMP) to address circumpolar demands for integrated Arctic biodiversity monitoring.
- The Sustainable Development Working Group (SDWG) of the Artic Council is carrying out the 'One Arctic-One Health' project with the aim of promoting knowledge-sharing and practices with regard to disease outbreaks, natural diseases, and related symptoms.

Korea Polar Research Institute

- KOPRI is currently carrying out research on changes in polar habitats and polar species' adaptation and evolution as a result of global warming.
- The research focuses on polar environments, biodiversity, ecosystems, etc., from the perspective of planetary and human health.
- KOPRI is building the scientific grounds for analyzing the potential risks of polar-borne infectious diseases and formulating response measures.