

The Status of Reactors, Accelerators and their Expanded Applications in Korea



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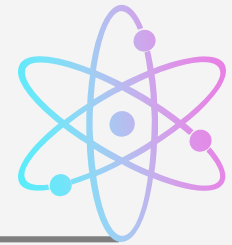


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PART. 1

Reactors and its Applications



Reactors and its Applications

1 · Research Reactor : HANARO



- Multi-purpose research reactor with a thermal power of 30MW



- World's 5th and Asia's 1st IAEA-designated ICERR*

** International Centres based on Research Reactors*



HANARO

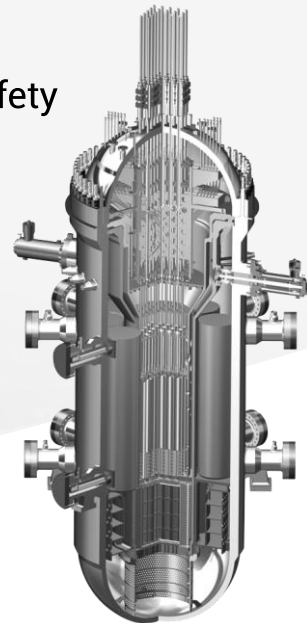


ICERR Designation Certificate

2 · Small Modular Reactors : SMART and i-SMR



- **SMART** (*System-integrated Modular Advanced Reactor*)
 - ▶ **World's first integral-type SMR with the Standard Design Approval**
 - Electric power of 110MW (*per module*)
 - Completed R&D and validation of a design with enhanced inherent safety
 - Accomplished Pre-Project Engineering (*PPE*) for the construction of SMART in Saudi Arabia (*Feb. 2019*)
 - Under a review process for the SDA



2 · Small Modular Reactors : SMART and i-SMR



○ i-SMR

- ▶ Innovative SMR to enter the global market in the 2030s



R&D Goals

The world's best safety, economic viability and load following capacity



Capacity

170MWe per module



Features

Integral component modularization

Reactors and its Applications

2 · Small Modular Reactor : SMART and i-SMR

Strengths of i-SMR

Simplified Design

Integral component modularization

Complete exclusion of serious accident through underground water tanks

No need to evacuate in case of an accident

Lower construction cost
(below \$4,000/kw)

Shorter construction period
(24months)

Complementary to the renewable energy

Hydrogen production

Safety

Economic Viability



3 · New Research Reactor

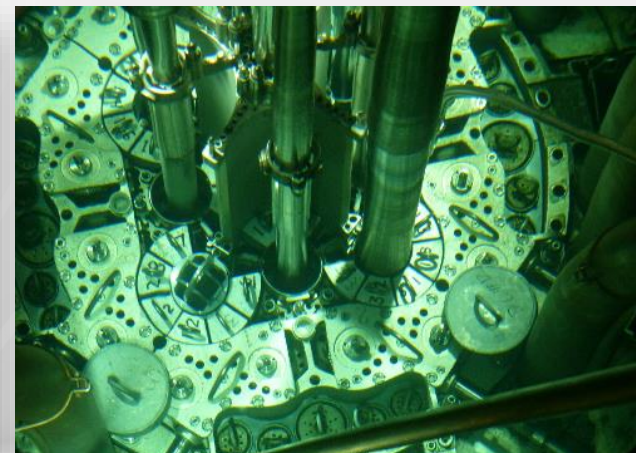


- Launched in 2012, and under demonstration phase (~2027)
 - ▶ Expansion of domestic medical and industrial radioisotopes supply
 - ▶ Contribution to supply and cost stabilization of the global RI market
 - ▶ Verification of the safety of the next-generation nuclear fuel* in 2019

* U-Mo flat-type fuel production



Site Plan for the New Research Reactor



U-Mo flat-type fuel

PART. 2

Accelerators and its Applications



Accelerators and its Applications

1 · Synchrotron Light Sources

- 3rd generation Pohang Light Source (PLS) and X-ray Free-Electron Laser (XFEL)



Applications

- Protein analysis
- Photosynthesis analysis
- Cell observation
- Atom-level semiconductor development
- Chemical catalytic reactions

Accomplishments

- Developed COVID-19 treatment (Regdanvimab) using PLS and received approval from European Medicines Agency

Accelerators and its Applications

1 · Synchrotron Light Sources

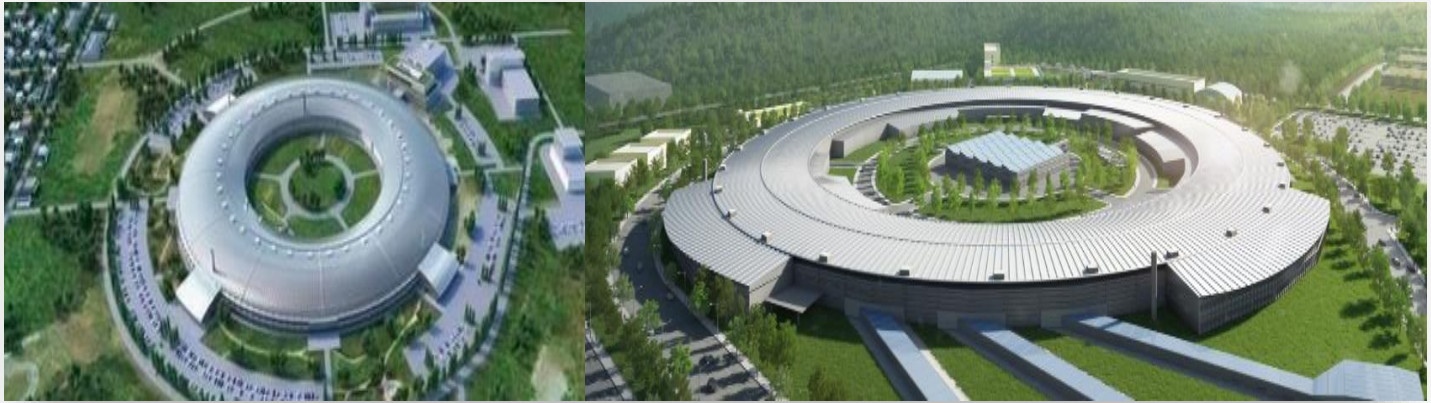
- 3rd generation Pohang Light Source (PLS) and X-ray Free-Electron Laser (XFEL)

	3 rd Generation PLS		XFEL
	Before	After (PLS-II)	
Shape	Round		Linear
Beam energy	2.5GeV	3.0GeV	10GeV
Brightness	100 million times brighter than the sunlight	100 times brighter than the previous model	100 million times brighter than PLS-II
Time Resolution	10 ⁻¹²		10 ⁻¹⁵
Characteristics of Lights	Wide range of wavelengths		0.1nm single wavelength (laser)
Analysis Level	Static analysis		Real time 3 dimensions Dynamic analysis
Applicable Area	Crystal protein, frozen cells		Monomolecular protein , living cells

2 · Multi-purpose Synchrotron Light Sources : 4th Generation Storage Ring



- World-class multi-purpose synchrotron light sources (2021~2027)



Multipurpose Synchrotron Radiation Source

- ▶ **Objective** Improving synchrotron light sources technology, supporting industry R&D and promoting basic & original technology research activities
- ▶ **Budget** 1 trillion and 45.4 billion won (≒USD 880 million)
- ▶ **Plan** Establishing one synchrotron light source (beam emittance below $0.1 \text{ nm} \cdot \text{rad}$) and 10 beamlines by 2027
 - ※ 30 beamlines will be established additionally in the near future.

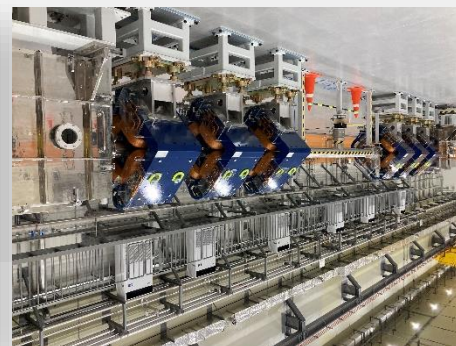
3 · Rare Isotope Accelerator : RAON



- Large-scale nuclear physics research facility with rare isotope (2011~)
 - ▶ **Objective** Boosting the advanced basic scientific research by using rare isotopes in the relevant fields such as nuclear science, astrophysics, material properties, and others
 - ▶ **Budget** 1 trillion and 518.3 billion won (\approx USD 1.28 billion)
 - ▶ **Capacity** Acceleration energy : 200mev/u, Maximum beam power : 400kW
 - ▶ **Characteristics** Combination of Isotope Separation On-Line (ISOL) and Inflight Fragmentation (IF)



Front View



Low Energy Experiment Device



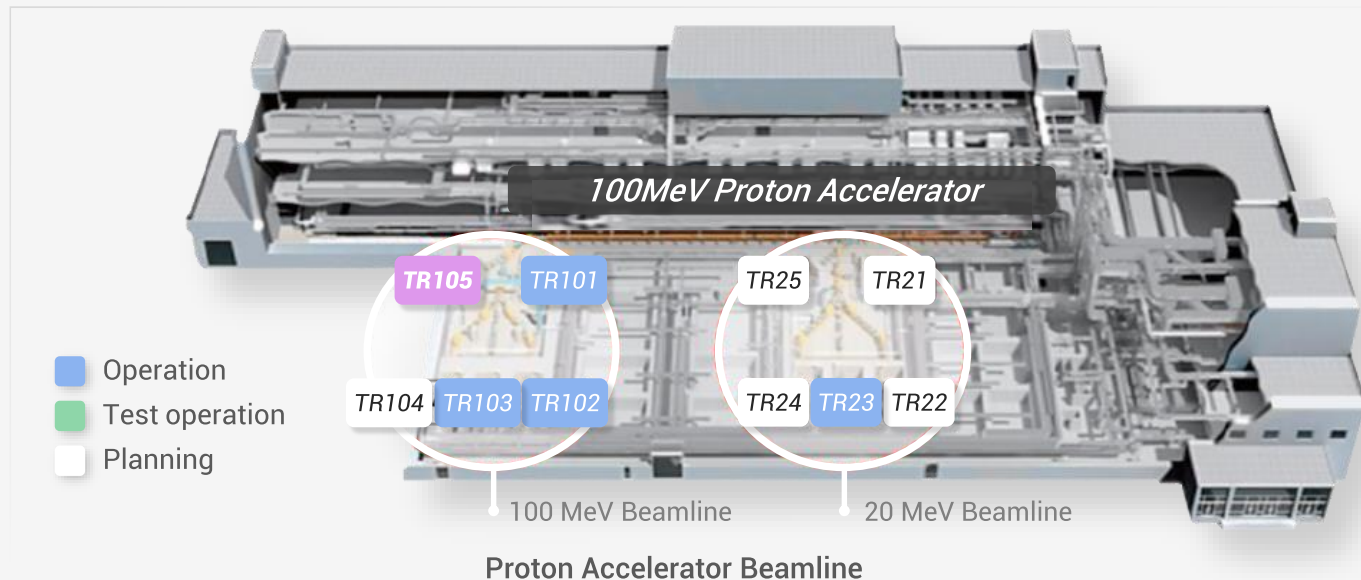
Injector

4 · Proton Accelerator Research Center



- Research facility for Nano-engineering/material engineering, Space & Basic science and biomedical areas (2013~)

- ▶ **Facilities** 4 beamlines
- ▶ **Applications** Material changes, neutron production, medical/industrial radioisotope production, and strategic semiconductor manufacturing
- ▶ **Plan** Accelerator system upgrade from 100MeV to 200MeV beam energy



PART. 3

Global Contributions and Plans



Global Contributions and Plans

1 · A Main Hub for Research Reactor Operation and Application



- Contributing to the research reactor technology development through the close cooperation with the IAEA and its member states



- Supporting the capacity building of IAEA member states on the applications
 - ▶ MOA between KAERI-PNRI for the construction of neutron activation analysis facilities and human resource development (*July. 2021*)



Digitalization of PUSPATI TRIGA MARK- II
in Malaysia (*2012~2014*)



Workshop with IAEA on Safety and Utilization
of Research Reactor (*2017*)

2 · Contributing to the Next Generation Innovative Nuclear System Development



- Participating in the International Project on Innovative Nuclear Reactors and Fuel Cycles (*INPRO*) since 2001



- Boosting the innovative nuclear system development and facilitating information-sharing among the members

- ▶ **Case 1** Joint case studies on advanced PHWR of India
- ▶ **Case 2** Dialogue Forums in 2012 and 2019



17th IAEA INPRO Dialogue Forum on Opportunities and Challenges in SMR (Ulsan, Korea, '19.7)

Global Contributions and Plans

3 · Supporting the Asia-Pacific Region through RCARO

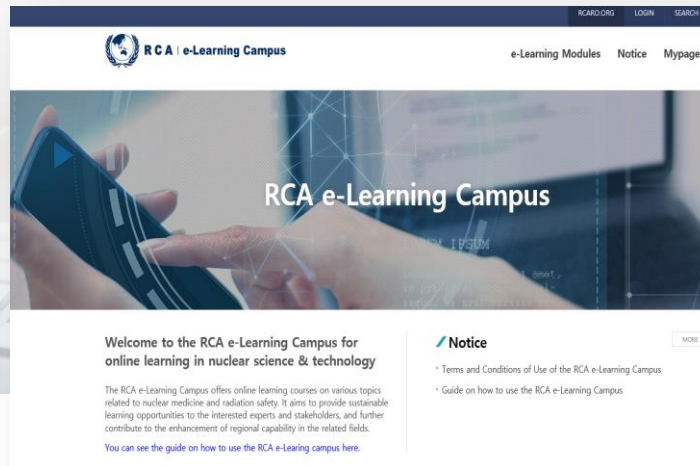


- Developing and operating RCA e-learning campus (Jun. 2020~)

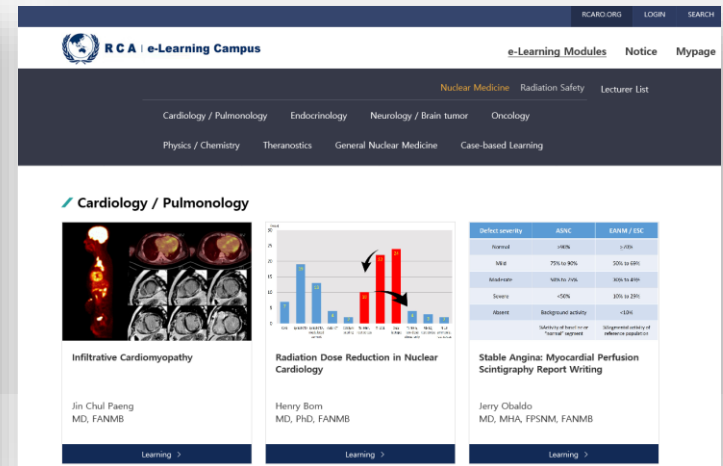
- ▶ About 170 modules on nuclear medicine and radiation safety



- Backing RCARO to provide various educational modules, including reactors and accelerators



RCA e-Learning Campus Main Page



Module Page





Thank you