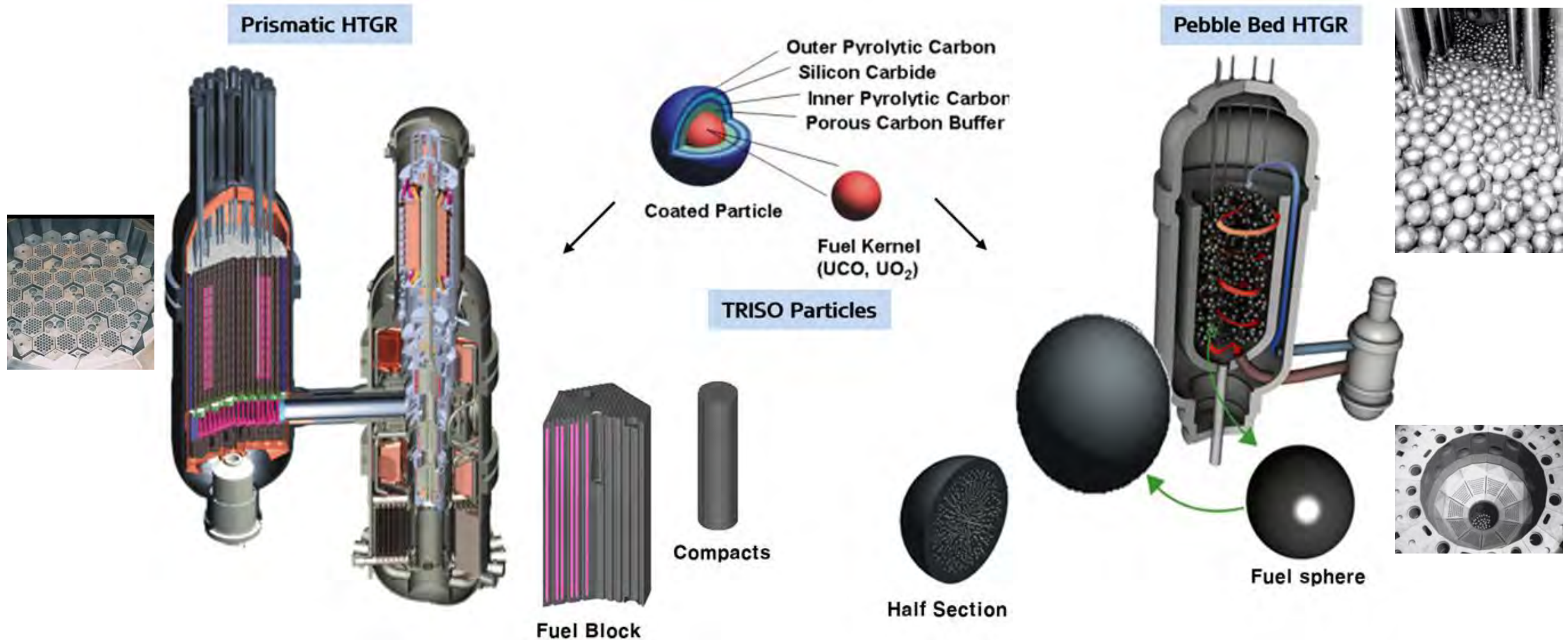


HTGR R&D Status for Non-Electric Application

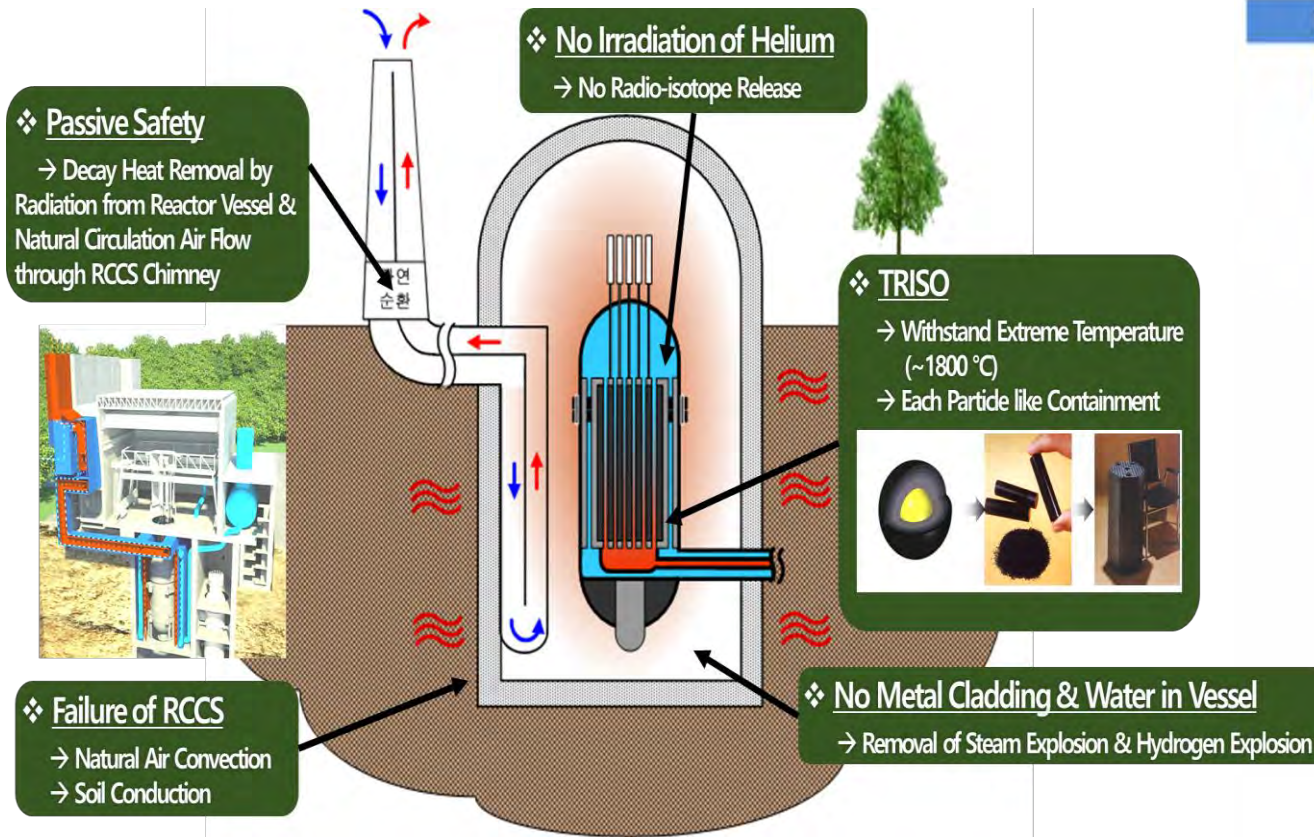
Chan Soo Kim
Korea Atomic Energy Research Institute
[**kcs1230@kaeri.re.kr**](mailto:kcs1230@kaeri.re.kr)

NEHA Workshop
BEXCO, Busan, Republic of Korea
April 26, 2024

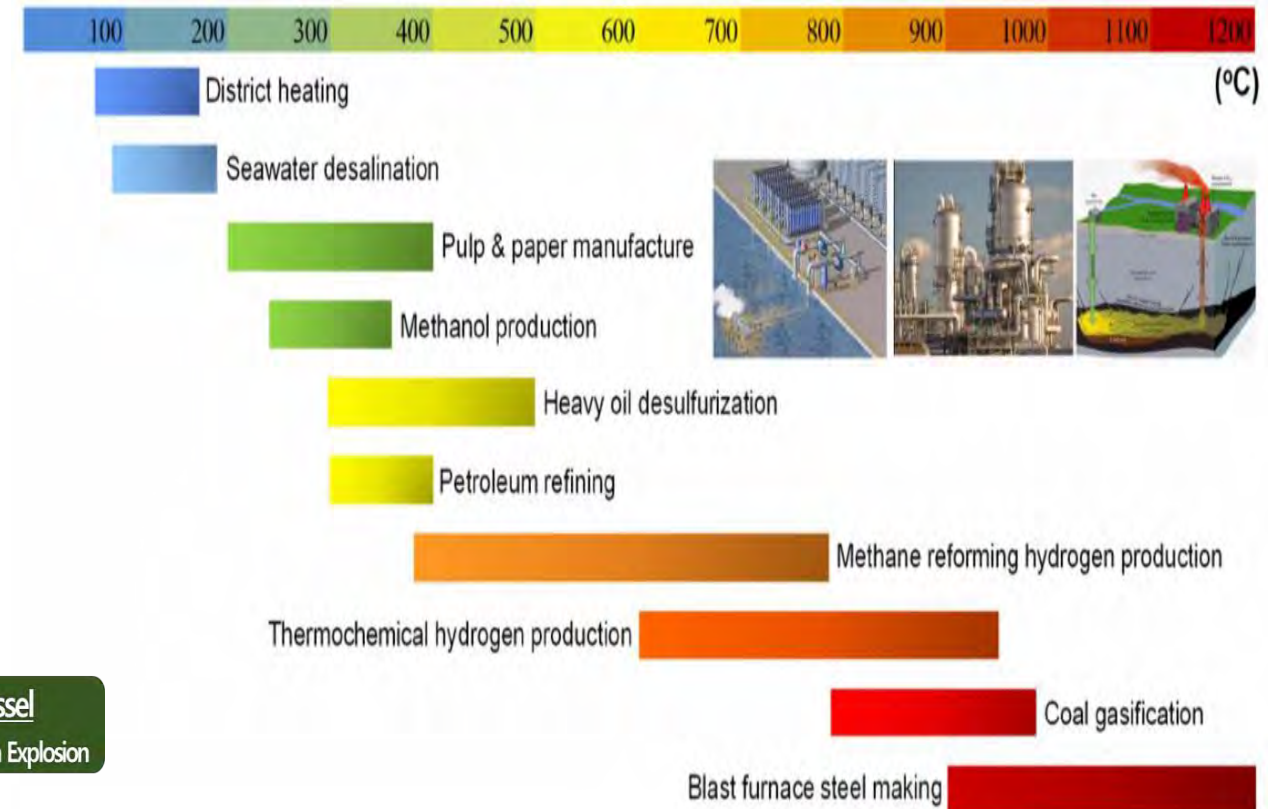
◆ TRISO (Fuel), Graphite (Moderator), Helium (Coolant)









◆ Inherent Safety



◆ Wide Application



HTGR Projects for NEA

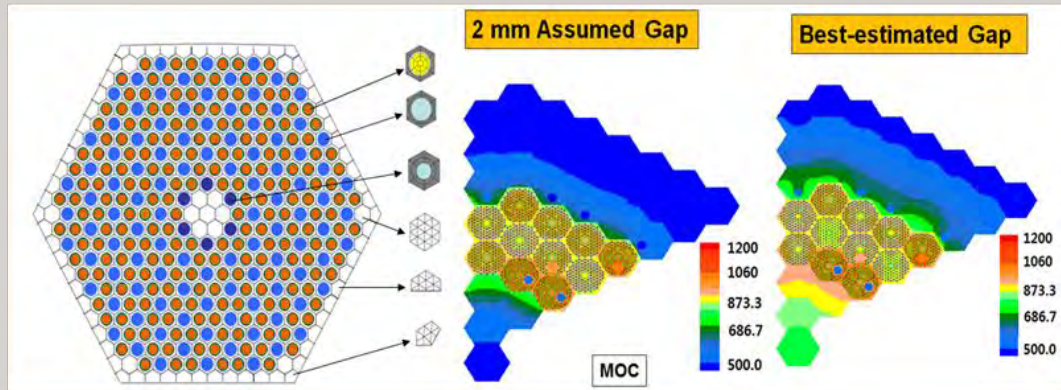
	Application	Project Name	Organization	Reactor Type
 EU	High Temperature Steam	GEMINI 4.0	Framatome SAS	HTGR
 Russia	Steam Methane Reforming	Hydrogen production coupled with HTGR	ROSATOM	HTGR
 Japan	Steam Methane Reforming	Hydrogen production coupled with HTGR	JAEA	HTGR (HTTR)
 China	High Temperature Steam	HTR600C	INET	HTGR
 US	Chemical Manufacturing	Dow and X-energy collaboration for chemical production	X-energy & Dow	HTGR
 Canada	District heating, hydrogen, off-site grid	Clean Energy Demonstration Innovation, Research	GFP	HTGR (MMR)

HTGR R&D History

R&D for HTGR	2017	2018	2019	2020	2021	2022	2023	2024
Nuclear R&D Phase	5 th Nuclear R&D Plan '17-'21			6 th Nuclear R&D Plan '22-'26				
VHTR R&D Projects	VHTR key Technologies			Advanced Reactor Key Technologies (VHTS)				
	Design and Analysis Code V&V Code Validation Test (RCCS, Flow Distribution) IHX-PCHE, Materials and TRISO Heat Utilization			Design and Analysis Code Improvement Materials and TRISO				
				Hydrogen Production (HTSE)				
International Collaboration				GIF VHTR System				
	GEMINI+			GEMINI 4.0				

Key R&D Products

VHTR Design Code



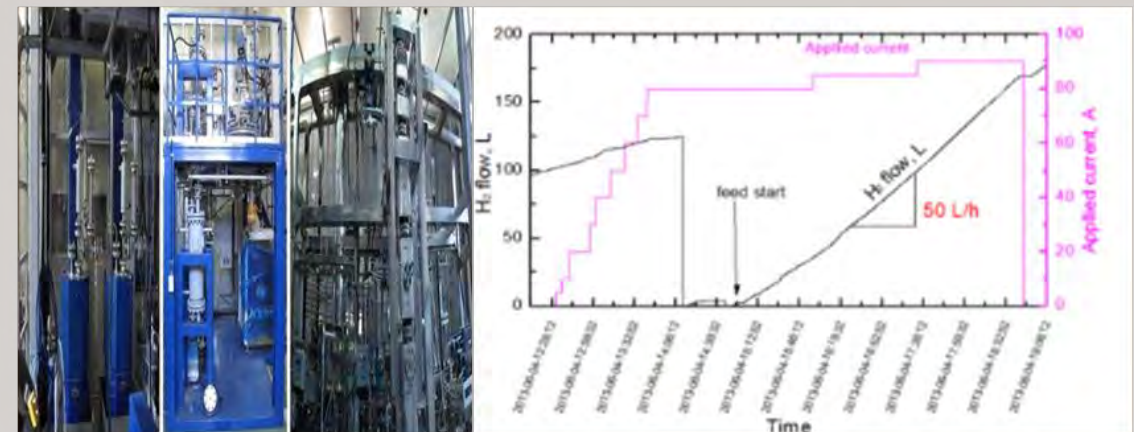
Helium Experimental Loop & Compact HX

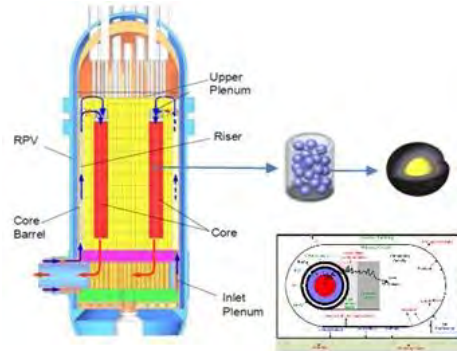


Lab-scale TRISO Fabrication Technology



Lab-scale High P SI Cycle (continued 8 hrs)





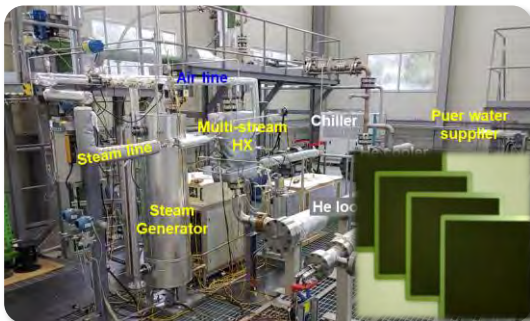
VHTR Performance Evaluation Technology

- High-precision core and safety analysis codes
- Radiation shielding analysis codes
- FP source/transportation analysis code



VHTR Materials Performance Verification

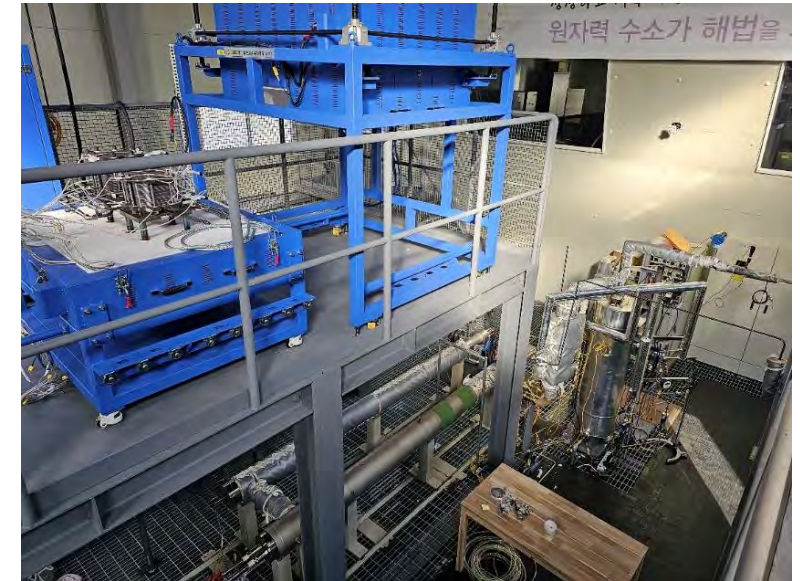
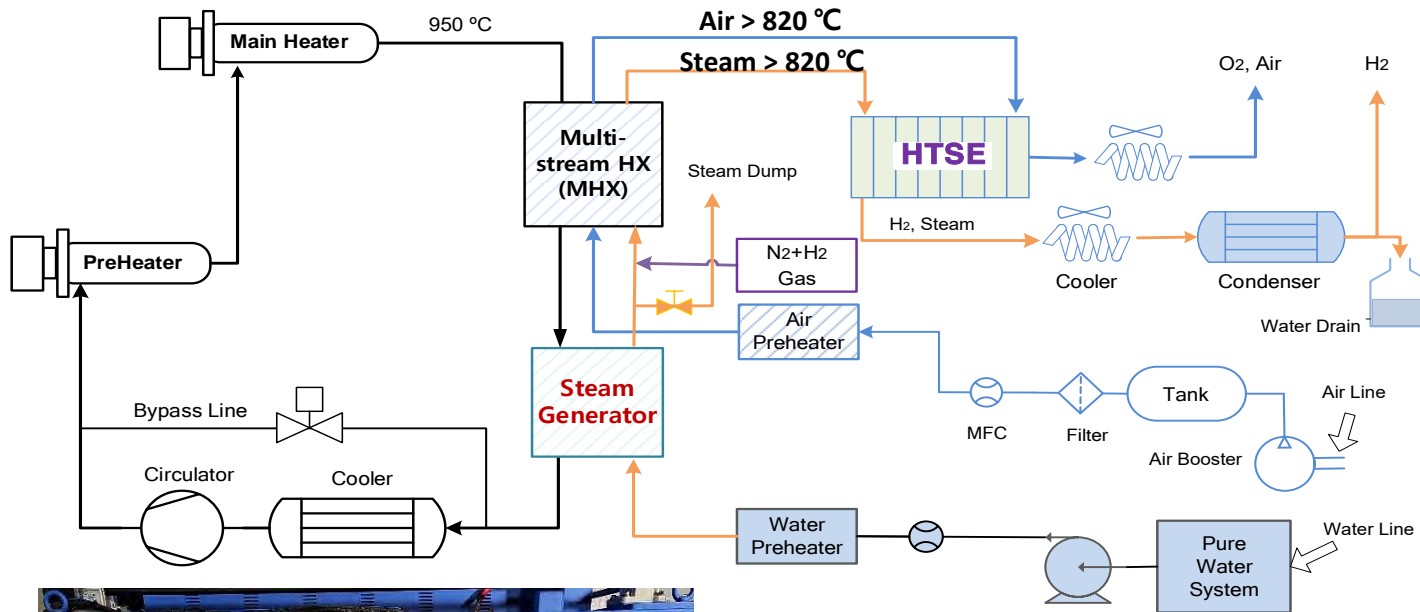
- Graphite oxidation test and DB with simulating VHTR accident condition
- Advanced TRISO coating technology
- A617 long-term life prediction for IHX



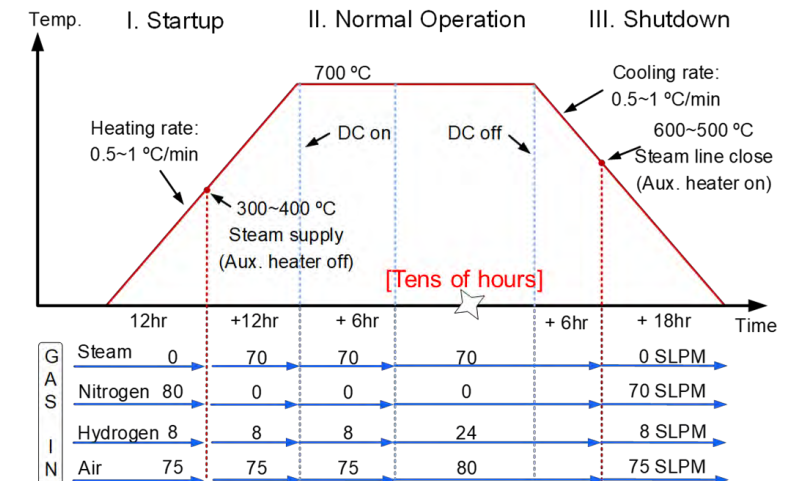
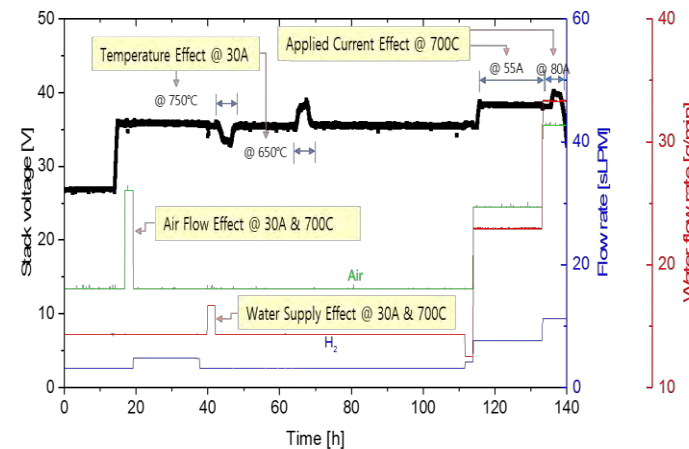
Coupled Technology between VHTR and HTSE

- SOEC module fabrication (6kWe)
- SOEC module performance test environment using Helium Experimental Loop (30kWe)
- Coupled analysis with VHTS and HTSE / High-precision tritium transportation analysis

Integral Test for Coupling HTSE & HELP



6 kWe SOEC stacks (POSCO Holdings)



KAERI's Collaborations for HTGR

Gen IV (VHTR, OECD-NEA)

- Korea, US, China, Japan, EU, France, Canada, UK, Switzerland, Australia
- Material('08~), Fuel('08~), H2 Production('10~), CMVB('22~)

VHTR MOU

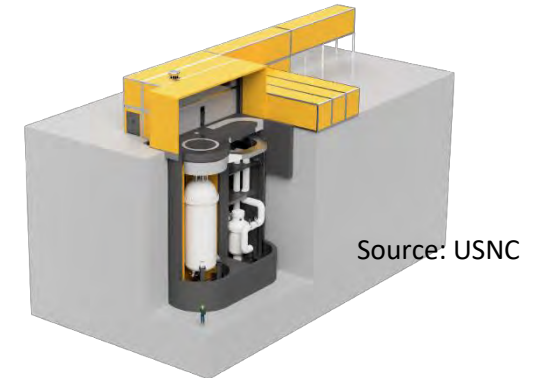
- KAERI, HEC, USNC(US)
- Development and Construction of MMR, HTGR, VHTR
- MMR Chalk River Project (Canada SMR Demonstration)

Nuclear HTSE MOU

- KAERI, RIST, POSCO, POSTECH, Uljin-gun, Gyeongsangbuk-do, Hyundai Engineering
- Development, Demonstration and Commercialization of Nuclear Hydrogen
- Collaboration Study between KAERI and POSCO Holdings (SOEC Module Performance Test using Helium Loop)

Alliance for Nuclear Heat Utilization

- 1 Institute, 1 Local Government, 6 Plant Engineering Companies, 5 End-user Companies
- New Business for Non-electric application of SMR heat

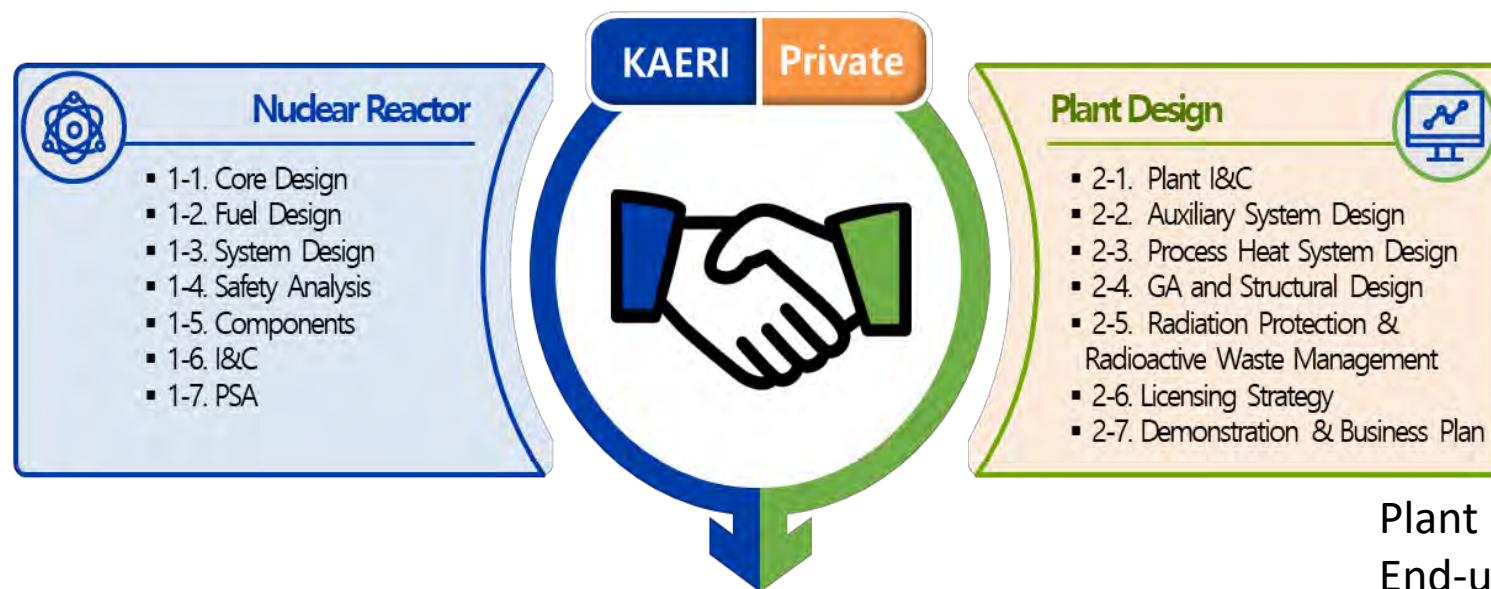


Advanced HTGR Development (Draft)

Public-Private Partnership Project for Advanced SMR

Yr	~'24	'24	'25	'26	'27	'28 ~	'34~
Classification	Government R&D	PPP Development Project				Demonstration Project	Commercialization Project
Leading Organizations	Government	Government 50 Private Sector 50					Private Sector
Project Details	Development of Technologies	(1 st Phase) Conceptual Design		(2 nd Phase) Basic Design		<ul style="list-style-type: none"> • PSAR · EIA, Detail Design (FSAR) • Site Selection · CP · OP 	Business







KAERI
Universities
Nuclear Industries



PPP Project for Basic Design of HTGR & Process Heat Plant

Plant E&C Industries
End-user Industries
Heavy Industries

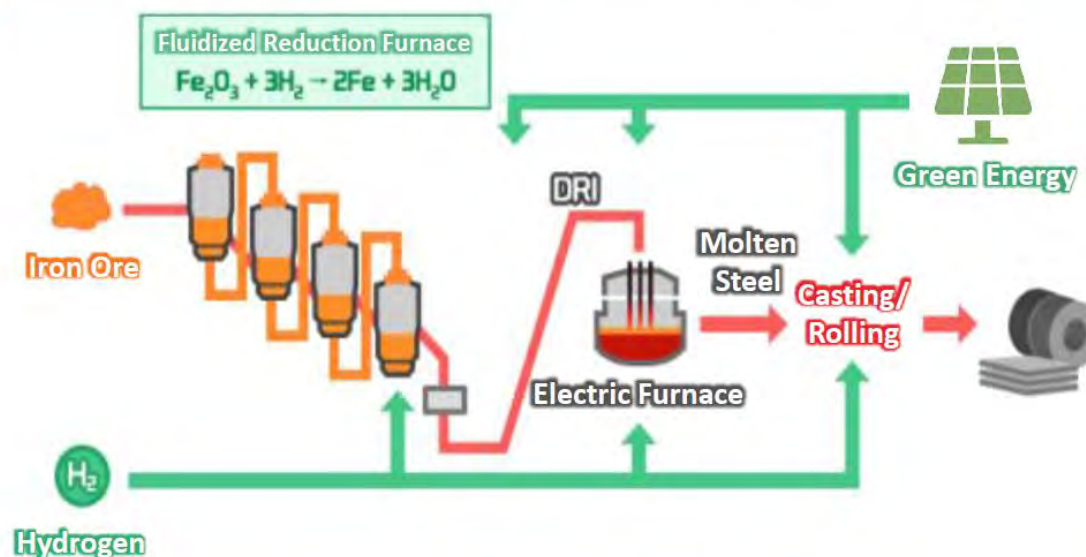
Future HTGR Applications in Korea

-  Closure
-  In operation
-  Under construction
-  Preparation for Construction
-  OPR1000
-  APR1400

Korean CO₂ Emission('18) (steel: 101 mil ton, petro-chemical: 62 mil ton)

Develop hydrogen reduction steelmaking technology for full application by 2040

HyREX*



When POSCO's crude steel production goes 100% hydrogen (38 Mt)

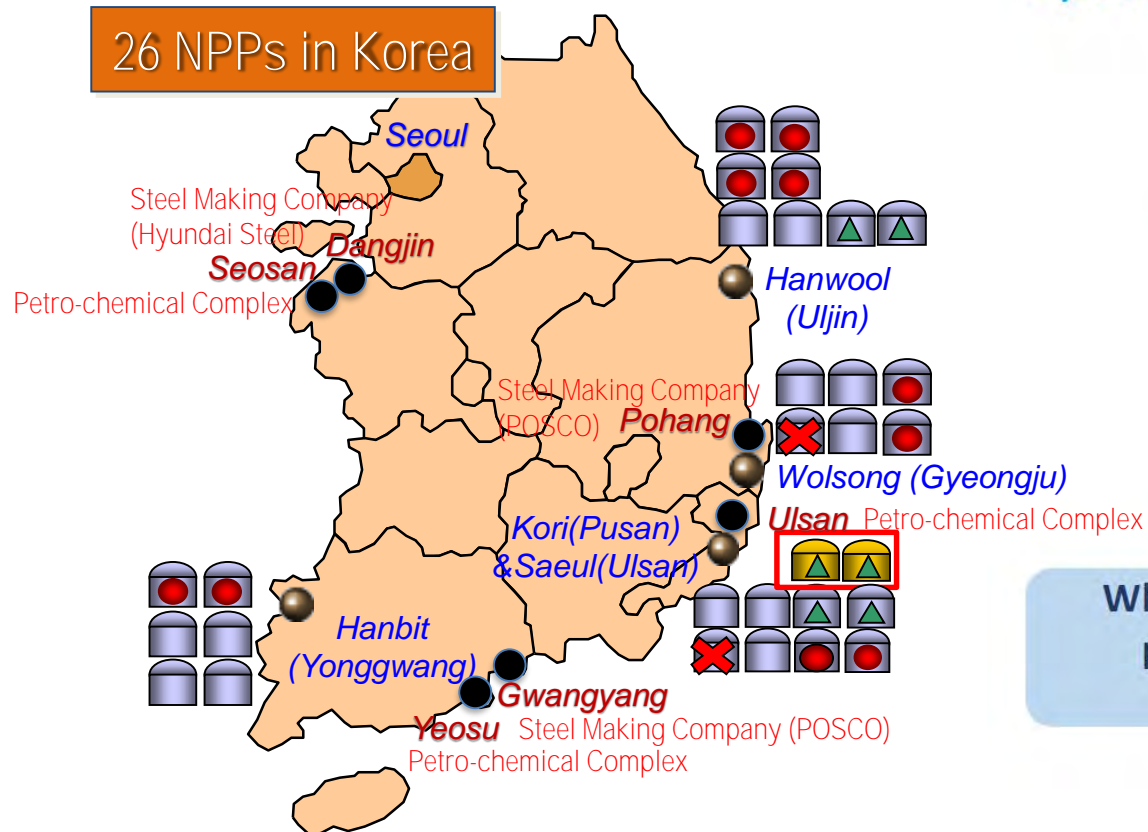


3.75 million tons of annual hydrogen consumption
(22% of domestic hydrogen demand in 2050)

Source: POSCO (2021)

*HyREX: Hydrogen Reduction Process

26 NPPs in Korea



◆ Carbon-Neutral Process Test with High Temperature Helium-heated Loop (draft)

