



Workshop on Non-Electric and Hybrid Applications of Nuclear Energy

Session 3: Existing operational experience and the challenges associated with operating a co-located system

Hydrogen production using JAEA's HTGR test reactor, “HTTR”

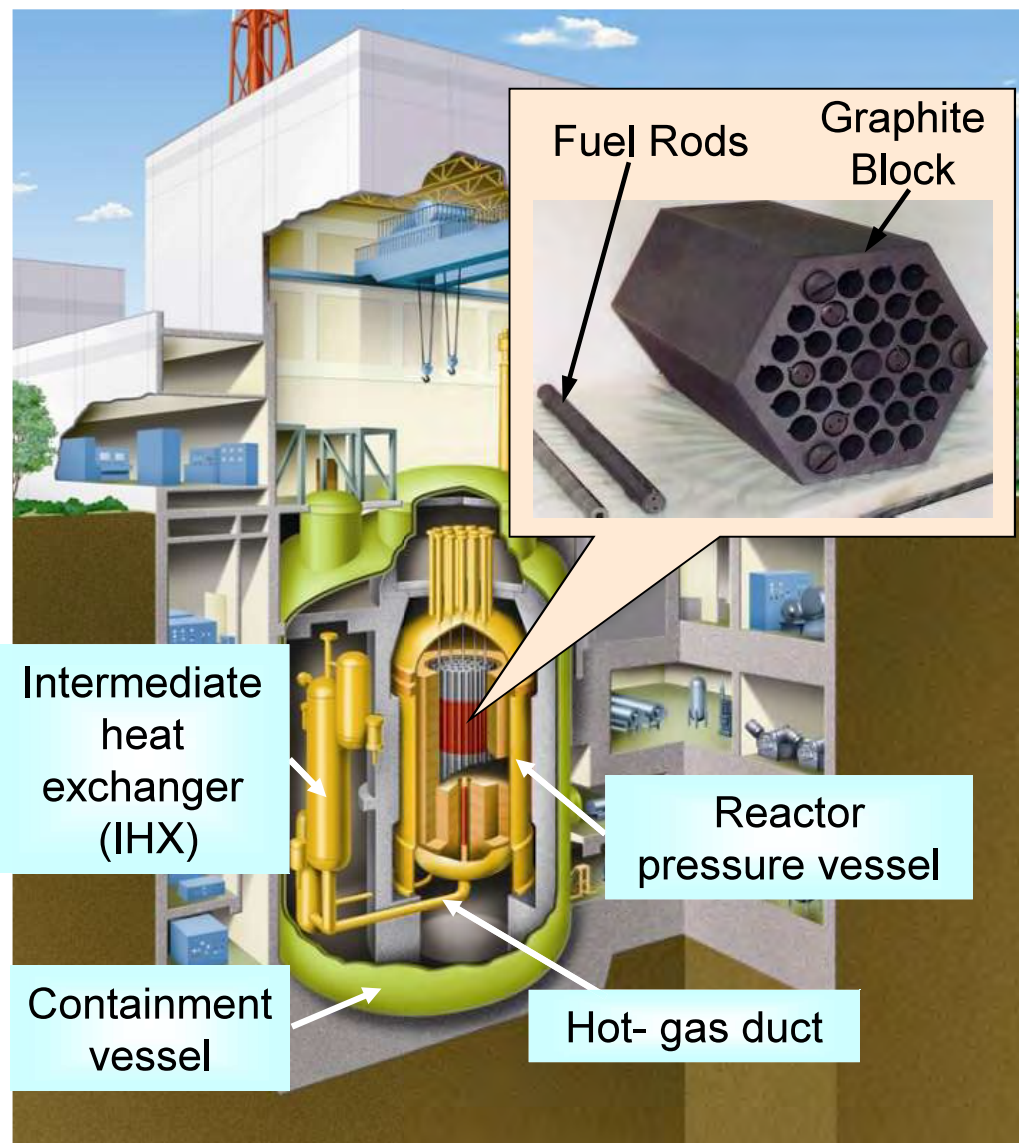
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HTTR (High Temperature Engineering Test Reactor)



Major Specifications

Thermal power	30 MW
Fuel	Coated fuel particle / Prismatic type
Core material	Graphite
Coolant	Helium
Inlet / Outlet temp.	395°C / 950°C
Pressure	4 MPa

Major Achievements

First criticality	: November 1998
Full power operation	: December 2001
50-day 950°C operation	: March 2010
Loss of forced cooling test (at 30% of reactor power)	: January 2011
Station blackout test	: January 2022
Loss of forced cooling test (at 100% of reactor power)	: March 2024

Japan's Policy on HTGR Development (1/2)

Green Growth Strategy Through Achieving Carbon Neutrality in 2050 (December 25, 2020)

Utilizing the HTTR which recorded world's highest temperature, the government will support, in addition to international safety demonstration, necessary technology development for massive and low-cost carbon-free hydrogen production by 2030. Simultaneously, development of carbon-free hydrogen production method using ultra high temperature heat including IS process and methane pyrolysis method will be supported. In supporting the development, the government will participate in technology development and verification giving thoughts to safety, economy, supply chain construction, regulatory compliance and so on, and will compose overseas joint projects considering the status of preceding overseas projects.

Roadmap of Growth Strategy for nuclear industry (HTGR)

	2021	2022	2023	2024	2025	~2030	~2040	~2050
HTGR	Restart of HTTR	Test to confirm “inherent safety” utilizing HTTR		Technology development required for carbon-free hydrogen production			Demonstration of connective technologies between carbon-free hydrogen plant and HTGR	Cost reduction by sales expansion and mass production
	Promotion of international cooperation utilizing HTTR capable of world’s highest 950°C output							
	Establishment of carbon-free hydrogen production technology utilizing high temperature heat (IS process, methane pyrolysis method, etc.)						Verification required for implementation	

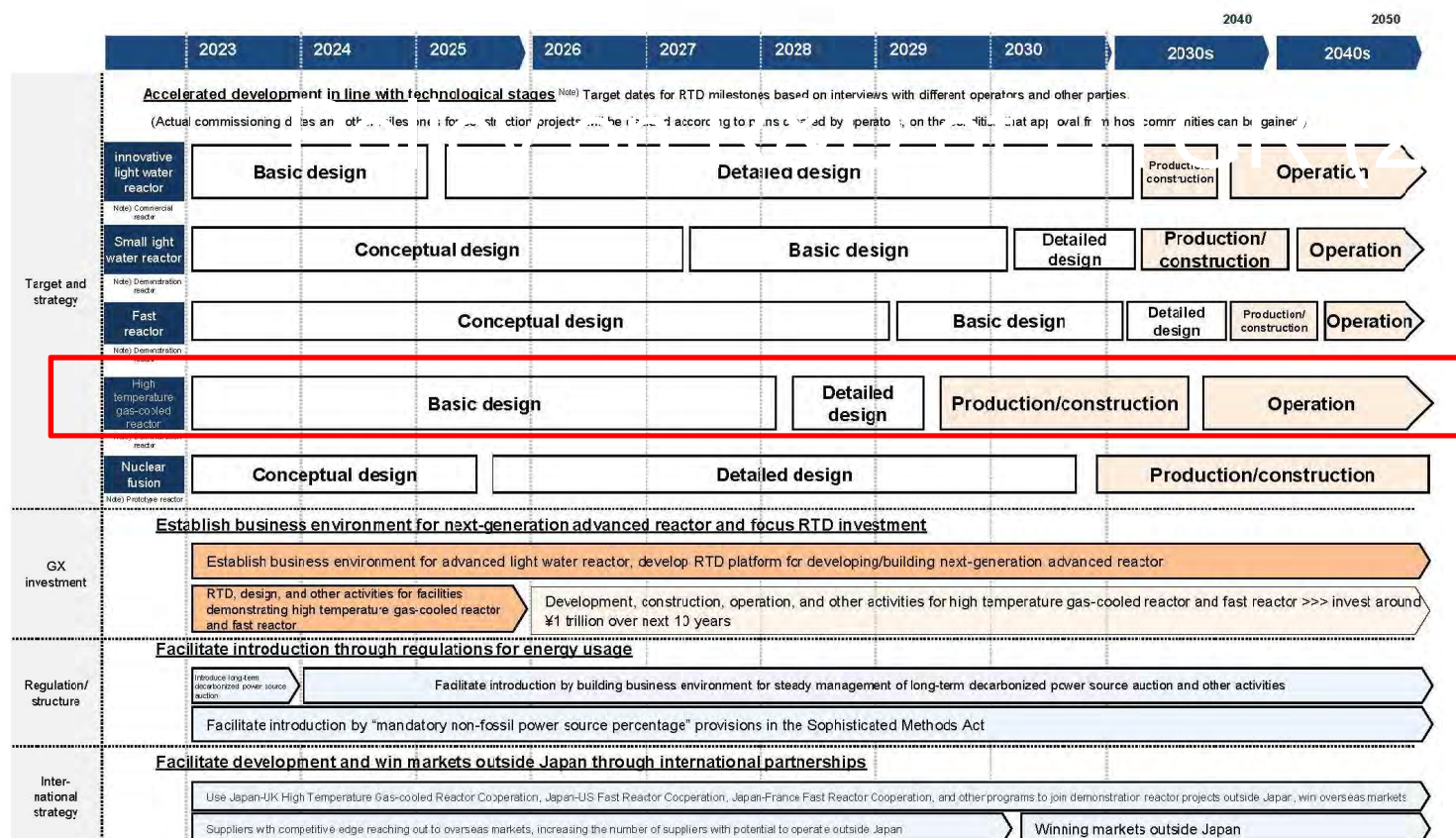
The Basic Policy for Realization of Green Transformation (GX) (February 10, 2023)

3) Utilization of nuclear power

On the premise of ensuring safety, we will materialize plans for building next-generation advanced reactors within the sites of existing nuclear power plants that have determined to be decommissioned.

<Future milestones> Case 16: Next-generation advanced reactor

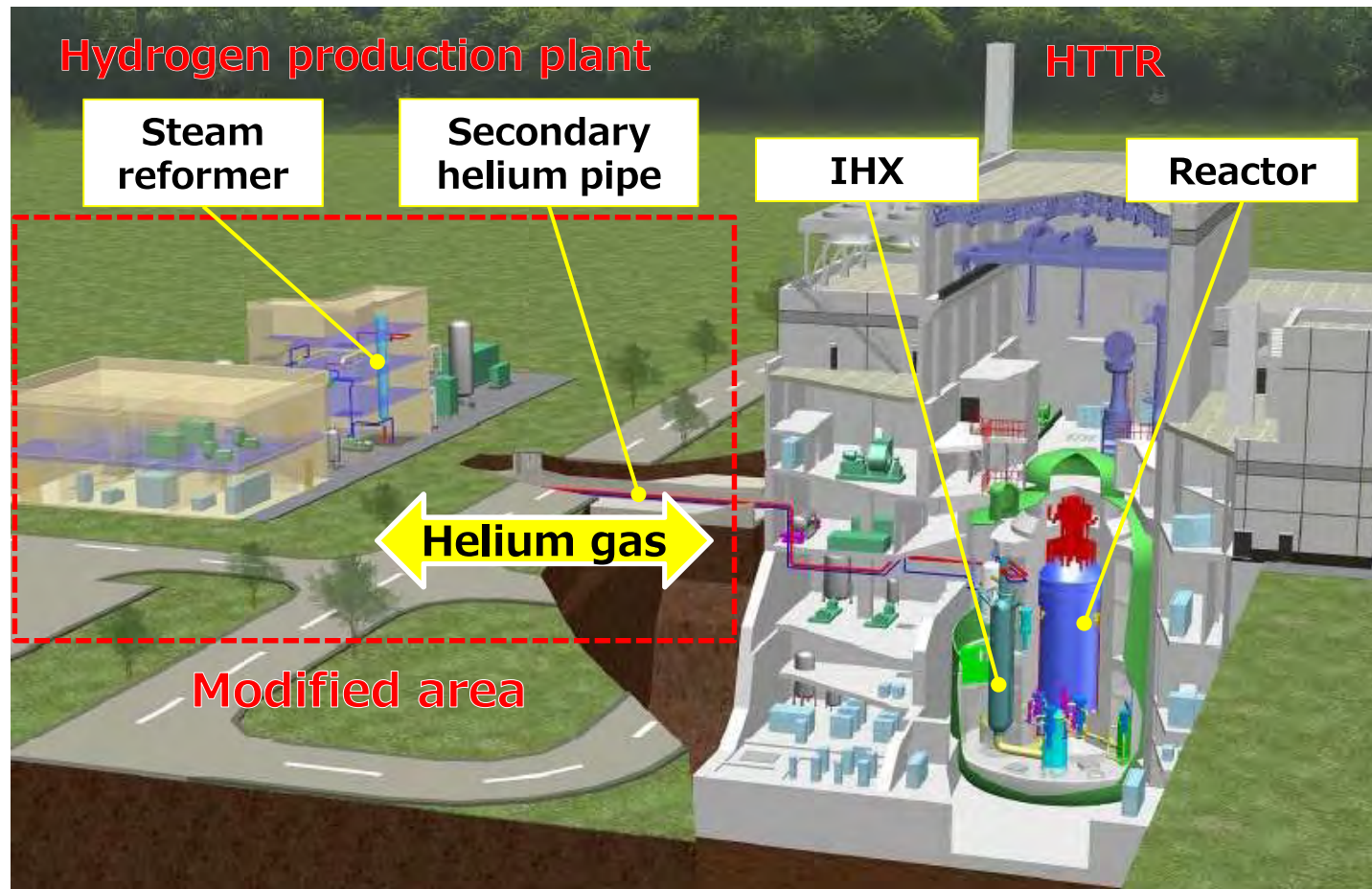
- Ensuring safety as top priority, develop/build next-generation advanced reactor embedded with new safety mechanism.



https://www.meti.go.jp/english/press/2023/pdf/0210_003c.pdf

Project “HTTR Heat Application Test”

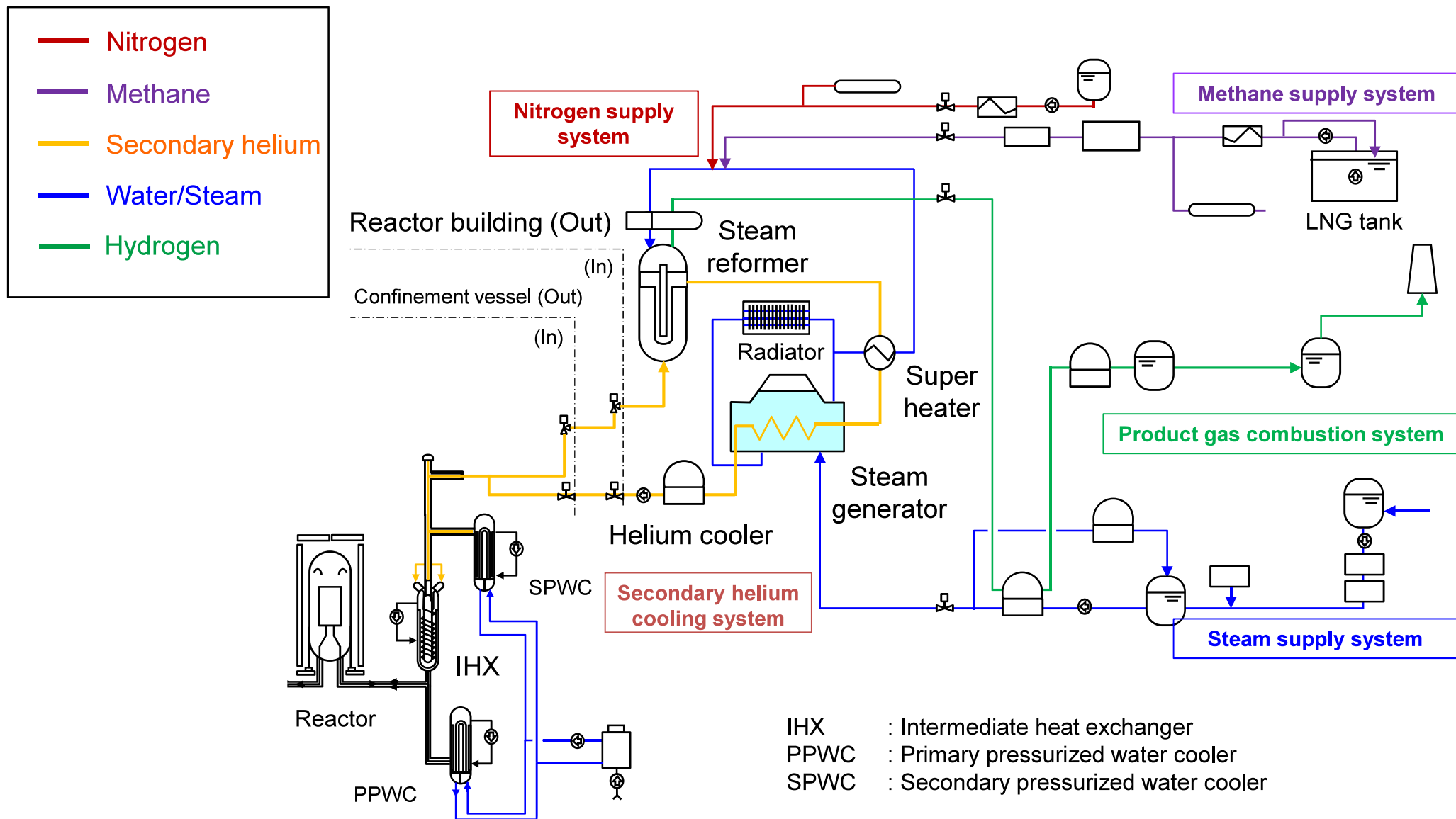
To establish a safety design for coupling HTGR and hydrogen production plant through the licensing by Nuclear Regulatory Authority.



Reference;

AOKI Takeshi, et al., “Development of Safety Design Philosophy of HTTR-Heat Application Test Facility”, ICONE30-1239, May 21-26, 2023, Kyoto, Japan

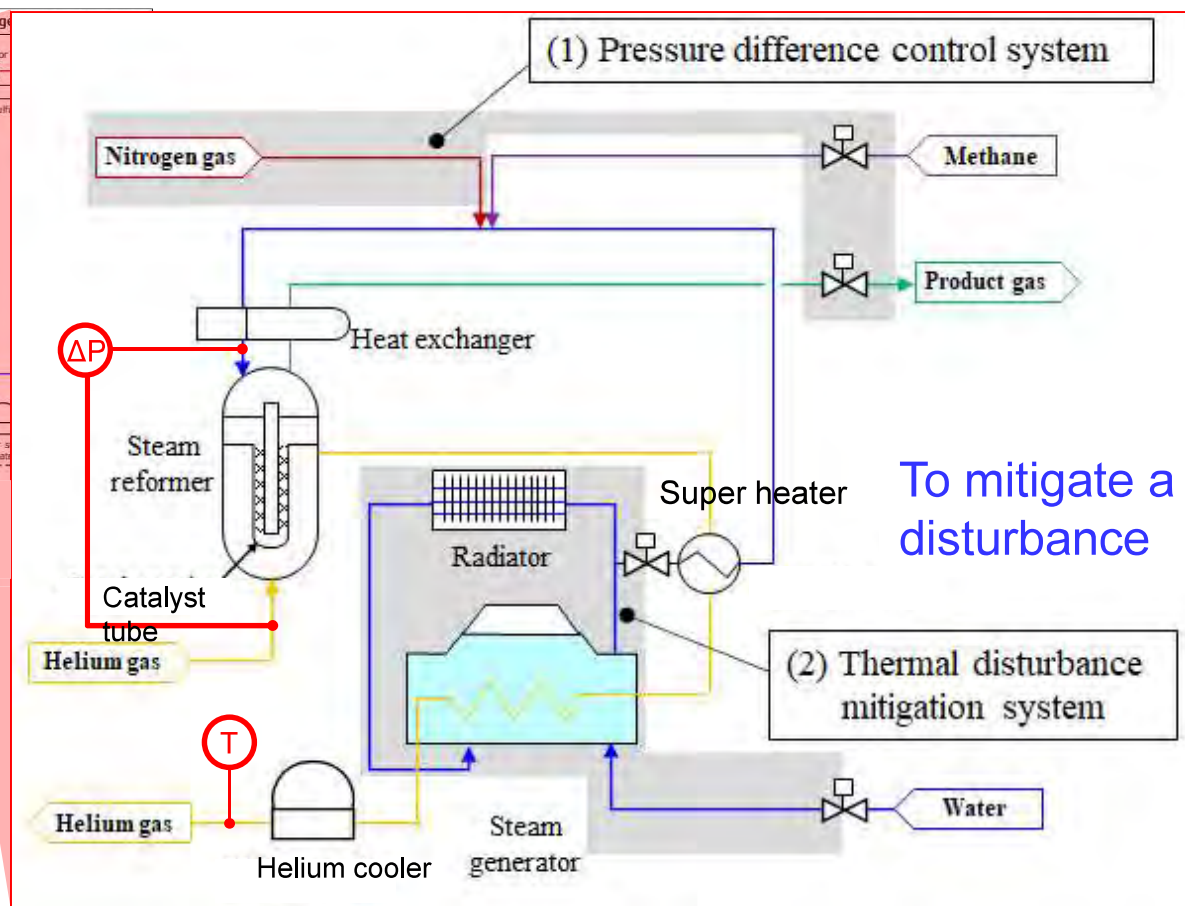
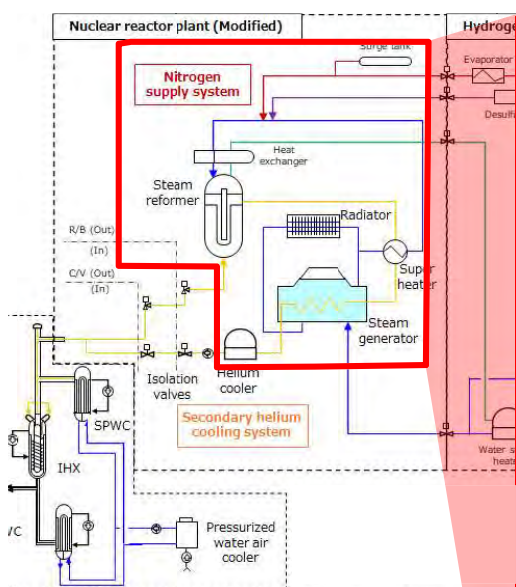
System diagram



Safety function

Keep normal operation of the nuclear reactor plant against abnormality in the hydrogen production plant

To ensure integrity of heat transfer tubes

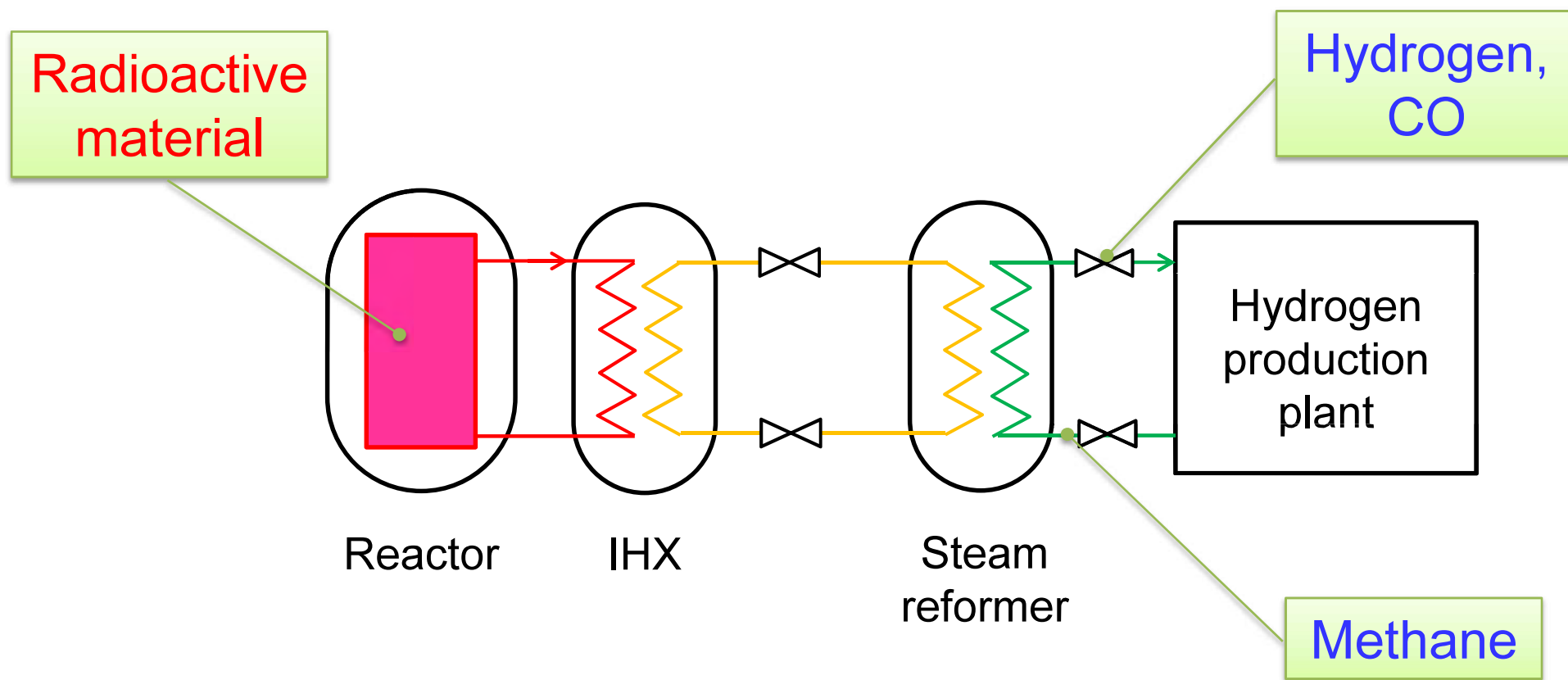


To mitigate a temperature disturbance

Reference;

AOKI Takeshi, et al., "Development of Safety Design Philosophy of HTTR-Heat Application Test Facility", ICONE30-1239, May 21-26, 2023, Kyoto, Japan

Hazardous material



Additional postulated events

Internal event		Water / steam ingress into secondary helium cooling system
External event	Internal hazard	Fire (Internal of nuclear reactor plant)
	External hazard	Fire, Explosion
		Poisonous gas leak
		Thermal hydraulic disturbance <ul style="list-style-type: none"> • Increase and decrease of heat removal of secondary helium cooling system

Conclusion

- JAEA is carrying out the system and safety design of HTTR hydrogen production plant.
- The safety design will be confirmed through the safety review by Nuclear Regulatory Authority.



Thank you for your attention!