Experience of HTTR licensing for Japan's New Nuclear Regulation

Summary / Objectives:

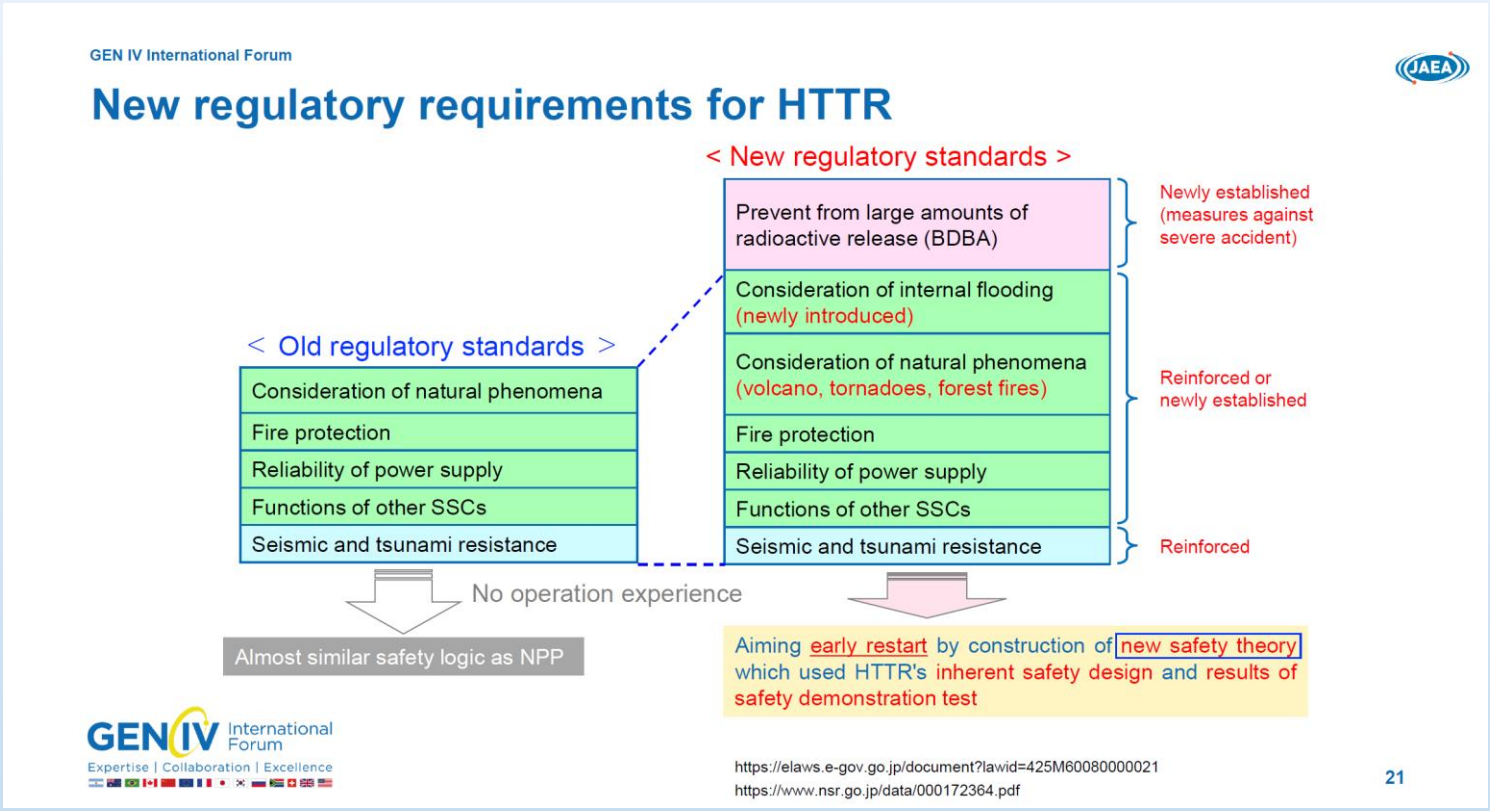
The new **safety theory which used HTTR's inherent safety design and results of safety demonstration test** has been approved by Nuclear Regulation Authority (NRA) . As a result, JAEA obtained permission by NRA toward the restart of the HTTR in conformity to the New Regulatory Requirements on 3rd June 2020. HTTR is expected to be restarted without any additional reinforcement due to its **own high-level inherent safety features**. Following the restart of HTTR, number of activities are planned: **Safety demonstration test** in OECD/NEA LOFC project; **Technology demonstration test of heat utilization system**; International cooperation and human-resource development utilizing the HTTR.

Meet the Presenter:

Dr. Etsuo Ishitsuka is the general manager of the HTTR Reactor Engineering Section at the Department of HTTR project in JAEA. He earned his Doctorate of Engineering from the University of Tokyo in 1999. His current works are the technology developments related to core management and operation. His team was in charge of the seismic evaluation of facilities and beyond design basis accidents in this licensing.

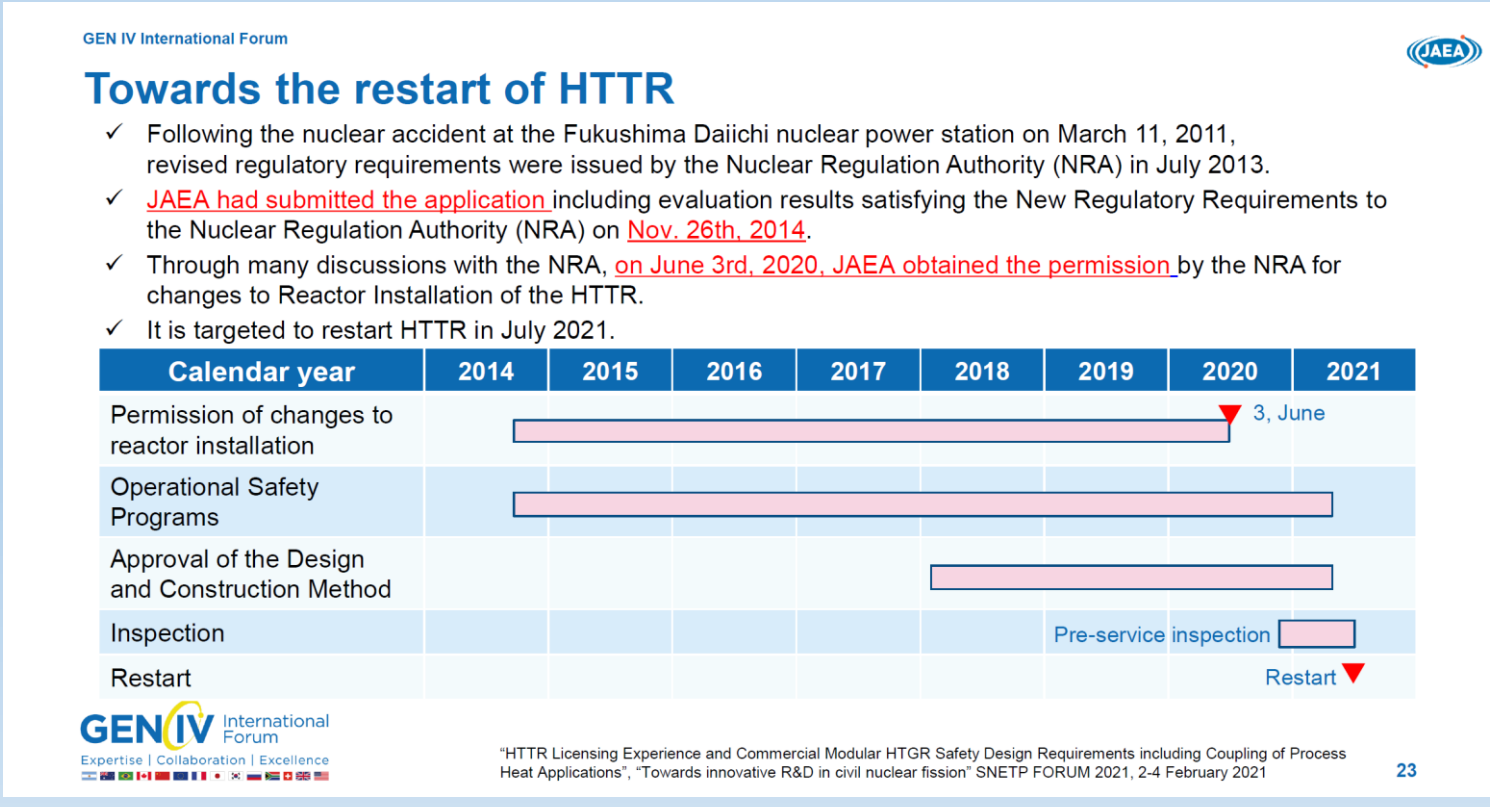
1. New regulatory requirements for HTTR

Comparing with the old regulatory standards, the new regulatory standards for HTTR are explained.



2. Towards the restart of HTTR

The activities towards the restart of HTTR on licensing are summarized.



3. Safety requirements

Comparison of safety requirements between Modular HTGRs and LWRs is shown.

GEN IV International Forum

Safety requirements

Safety requirements		Modular HTGRs	LWRs
Design extension condition (DEC)		DEC without significant fuel degradation	DEC without significant fuel degradation DEC with core melting
Reactor shutdown		At least two diverse and independent means (Inherent design features is regarded as one of means)	At least two diverse and independent systems
Heat removal from core		Passive cooling from the outside surface of reactor vessel (Passive cooling)	In shutdown states: Residual heat removal (Forced cooling) In accident condition：Emergency core cooling (Forced cooling)
Confinement of radioactive materials	Fuel integrity	In operational states and in accident conditions	In operational states (normal operation and AOO)
	Containment system	Confinement (i.e., vented low-pressure containment)	Containment Vessel
Additional specific considerations		Mitigation of air and water ingress into core during accidents	-

GEN IV International Forum
Expertise | Collaboration | Excellence

"HTTR Licensing Experience and Commercial Modular HTGR Safety Design Requirements including Coupling of Process Heat Applications", "Towards innovative R&D in civil nuclear fission" SNETP FORUM 2021, 2-4 February 2021

4. Safety importance classification

Unique classification of the HTTR different from the NPP was proposed to the NRA by explaining the inherent safety design and results of safety demonstration tests.

GEN IV International Forum

Safety importance classification

HTTR safety characteristic

With lower power density than LWRs (~2.5MW/m^3 *vs* >50MW/m^3) and large heat capacity of graphite core, the HTTR can maintain in a stable state when the cooling function is lost completely, and further even the shutdown function and cooling function are lost simultaneously.

Safety importance classification

Reviewed with reference to "The guide* ".

Classification of importance in seismic design

Reviewed with reference to "The rule of seismic importance classification of research reactor".

Safety importance
PS1,2: Prevention System
MS1,2: Mitigation System

Seismic importance : (S, B, C)

Unique classification of the HTTR different from the NPP was proposed to the NRA by explaining the inherent safety design and results of safety demonstration test.

GEN IV International Forum
Expertise | Collaboration | Excellence

* https://elaws.e-gov.go.jp/document?lawid=425M60080000021
https://www.nsr.go.jp/data/000172364.pdf

5. HTTR safety review results by NRA (1/2)

The results of HTTR safety review by NRA related to earthquake, tsunami and SSCs integrity are explained.

GEN IV International Forum

HTTR safety review results by Nuclear Regulation Authority (1/2)

Major discussion item		Regulatory review condition	Regulatory review results	Additional countermeasures
Earthquake	Design seismic ground motion	Raised from 350 gal to 973 gal	No large-scale reinforcement due to the degradation of the SSCs.	Not required
	Re-evaluation of seismic design classification	Some of structures, systems and components (SSCs) were downgraded taken into account the results of safety demonstration tests. ➢ Core heat removal: S class to B class ➢ Reactor internal structure: S class to B class.		
Tsunami evaluation		Assumption of tsunami height for evaluation : 17.8 m from sea level	Tsunami does not reach the site because siting location is 36.5 m high from the sea level.	Not required
Evaluation of integrity of SSCs against natural phenomena such as tornado, volcano, etc.		● Design basis tornado wind speed: 100 m/s ● Thickness of descent pyroclastic material by volcano: 50 cm	● All SSCs needed to be protected are installed inside the reactor building ● Fire proof belt necessary around reactor building.	Fire proof belt was required.

6. HTTR safety review results by NRA (2/2)

The results of HTTR safety review by NRA related to fire, reliability of power supply and BDBA are explained. HTTR will restart without significant additional reinforcements due to its inherent safety features.

GEN IV International Forum

HTTR safety review results by Nuclear Regulation Authority (2/2)

Major discussion item	Regulatory review condition	Regulatory review results	Additional countermeasures
Fire	Burnable materials in and around the reactor building was additionally evaluated.	● Amount of burnable materials in the reactor building is limited. ● Cables necessary to be protected against fire	Cable protection against fire was required.
Reliability of power supply	Emergency power supply failure was evaluated.	Decay heat is removable from the core without electricity.	Only portable power generator for monitoring during accident is required.
Beyond design basis accident (BDBA)	Postulated BDBAs ➢ DBA + failure of reactor scram ➢ DBA + failure of heat removal from the core ➢ DBA + failure of containment vessel	● No core melt occurs in all BDBAs.	

(DBA : Design Basis Accident)

HTTR will restart without significant additional reinforcements due to its inherent safety features.