GEN IV International Forum[SM]

SFR SAFETY DESIGN CRITERIA (SDC) AND SAFETY DESIGN GUIDELINES (SDGs)

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Meet the Presenter

Mr. Shigenobu Kubo, Deputy Director of the Reactor Systems Design Department in the Sector of Fast Reactor and Advanced Reactor Research and Development of the JAEA, has been engaged in sodium-cooled fast reactor development since 1989, when the Heisei-era in Japan began (the Heisei-era ended in 2019). His specialties are SFR system design, safety design and related R&Ds. Currently, he is involved in the development of safety design criteria for SFR as the Chair of the GIF SDC task force. He has been involved with the GIF SDC task force since its beginning in 2011.

He previously participated in the Feasibility Study on commercialized fast reactor cycle systems (1999-2006) and the Fast Reactor Cycle Technology Development project (2006-2011) and served as the design task leader and severe accident task leader in the France-Japan ASTRID collaboration. One of his most impressive accomplishments is the work performed on the EAGLE project (SFR severe accident experiments using IGR and out-of-pile experimental facility in Kazakhstan).

He earned a Master of Science in nuclear engineering in 1989 from Nagoya University, Japan.

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Contents

- Background
- Elements to be considered
  - GIF's Safety Goals & Basis for Safety Approach
  - Characteristics of SFR
  - Lesson from Fukushima Daiichi NPPs Accident
- Development of SDC and SDGs for Gen IV SFR
  - Safety Design Criteria (SDC)
  - Safety Design Guidelines (SDGs)
    - SDG on Safety Approach
    - SDG on Structures, Systems and Components (SSCs)
- Concluding Remarks

Background

- For nuclear power plants, IAEA has systematically developed international safety standards, which form a hierarchical structure. The upper-level standards are applied to any reactor types; however, the lower-level standards are mainly for existing LWRs.
- Many countries are developing Generation IV (Gen IV) reactors by themselves, or occasionally, they work together to make progress toward the demonstration of their reactors. Therefore, there is a growing demand to set global standards for Gen IV reactors.
- To meet the demand, GIF created a task force (TF) to develop safety design criteria (SDC), called SDC TF, in 2011.
- The SDC TF started with the development of the SDC and safety design guidelines (SDGs) for SFRs because the technical maturity of SFRs is the highest among the other Gen IV reactor systems. It will then work on the documents for other systems.

- Elements to be considered
  - GIF's Safety Goals & Basis for Safety Approach
  - Characteristics of SFR
  - Lesson from Fukushima Daiichi NPPs Accident

GIF's Safety & Reliability Goals

SR-1: Excel in operational safety and reliability

Safety and reliability during normal operation, and likely kinds of operational events that set forced outage rate

SR-2: Very low likelihood & degree of reactor core damage

Minimizing frequency of initiating events, and design features for controlling & mitigating any initiating events w/o causing core damage

SR-3: Eliminate the need for offsite emergency response

Safety architecture to manage & mitigate severe plant conditions, for making small the possibility of releases of radiation

GIF's Basic Safety Approach

- ***Defence-in-depth***
- ***A combination of deterministic and risk-informed safety approach***
- ***Safety to be built-in to the design, not added-on***
- ***Emphasis on utilization of inherent and passive safety features***

Defence-in-depth (DiD) & Plant States

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Defence-in-Depth level and Plant States (including Severe Accident) based on IAEA INSAG-12 & SSR-2/1 (Rev.1, 2016)

<table>
<tr><th colspan="6">Defence-in-Depth Levels</th></tr>
<tr><th>Level 1</th><th>Level 2</th><th>Level 3</th><th colspan="2">Level 4</th><th>Level 5</th></tr>
<tr><td colspan="5">Plant states (considered in design)</td><td rowspan="4">Off-site emergency response (out of the design)</td></tr>
<tr><td colspan="2">Operational States</td><td colspan="3">Accident conditions</td></tr>
<tr><td rowspan="2">Normal operation</td><td rowspan="2">Anticipated operational occurrences</td><td rowspan="2">Design basis accidents</td><td colspan="2">Design extension conditions</td></tr>
<tr><td>Without significant fuel degradation</td><td>With core melting</td></tr>
</table>

- Elements to be considered
  - GIF's Safety Goals & Basis for Safety Approach
  - Characteristics of SFR
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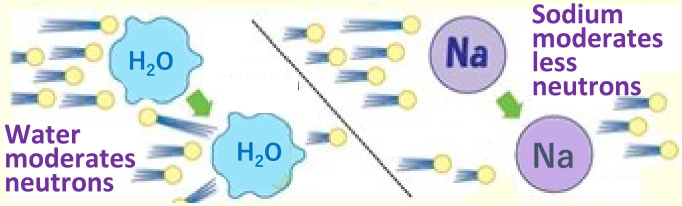
Characteristics of Sodium

Advantages

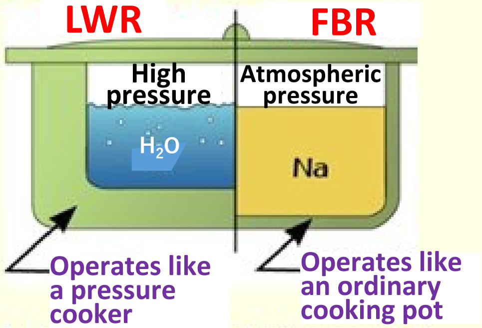
Uses neutrons efficiently



Neutrons produced in fission can be efficiently used because sodium moderates neutrons less than water does.

Sodium is suitable for fast spectrum reactor.

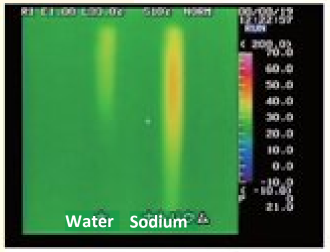
Enables low-pressure plant



No need to pressurize it because the boiling point of sodium is very high (about 880℃)

Transfers heat faster

Heat transfer test
Left: Water
Right: Sodium



Thermographic measurement
Sodium transfers heat faster than water.

Heat generated in a reactor core can be efficiently removed.

Use of sodium coolant enables us to adopt the compact, high performance cooling system.

Disadvantages (overcome by design)

Reacts with water and air

Reaction with air

Reaction with water

Design measures must be taken to prevent chemical reaction because it is highly reactive.

Prevention and detection of leak is important.

Must be preheated to use

Soft solid state at room temperature

Liquid-state sodium can be used. (melting point 98℃)

Sodium requires preheat and heat retention.

Sodium Combustion

- **It is less intense compared with general industrial products (e.g. gasoline).**
- **Sodium is manageable if properly handled, just like other industrial products.**

✓ **Major leak is unlikely to occur thanks to the low pressure system.**

✓ **Even if sodium leaks, its combustion is less intense.**

Measures

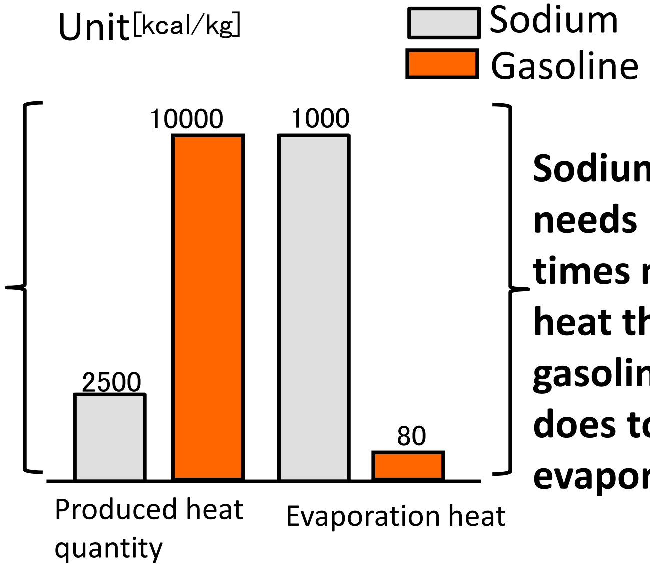
✓ **Nitrogen atmosphere to prevent combustion**

✓ **Double-wall piping to prevent leak**

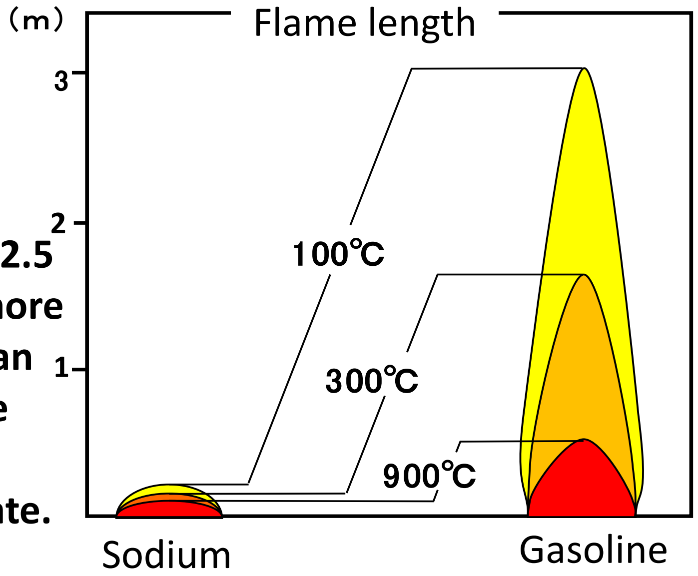
✓ **Leak detectors to limit the amount of leak**

Less intense than gasoline combustion

Produced heat is 1/4 of that of gasoline.



Sodium needs 12.5 times more heat than gasoline does to evaporate.



Low pressure system

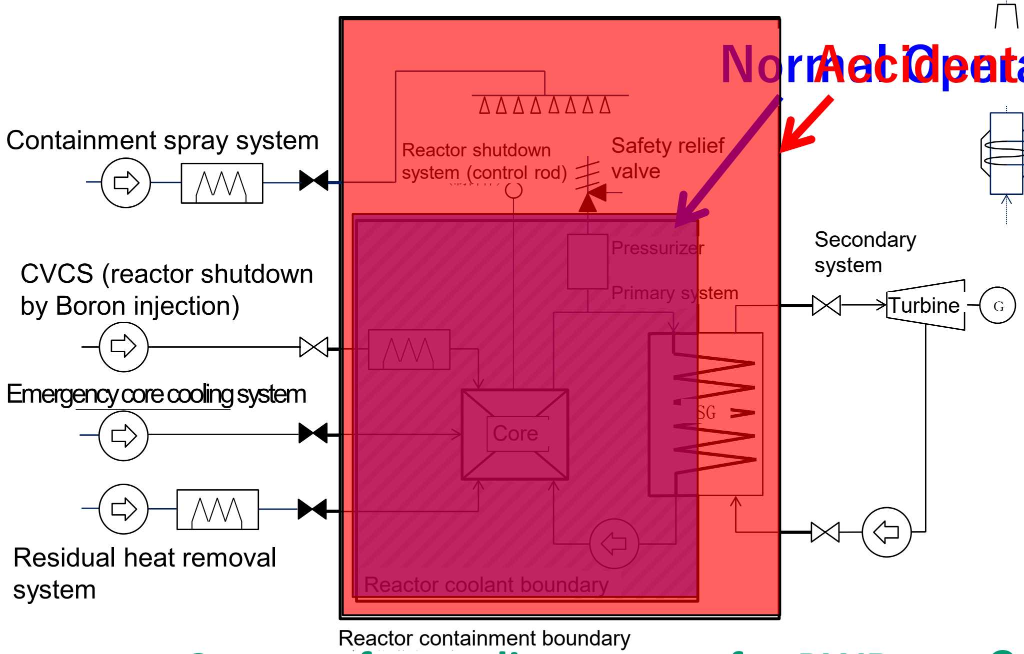
No need to pressurize sodium coolant because of its high boiling point

Boiling point
- **Sodium: 883℃**
- **Water: 100℃**

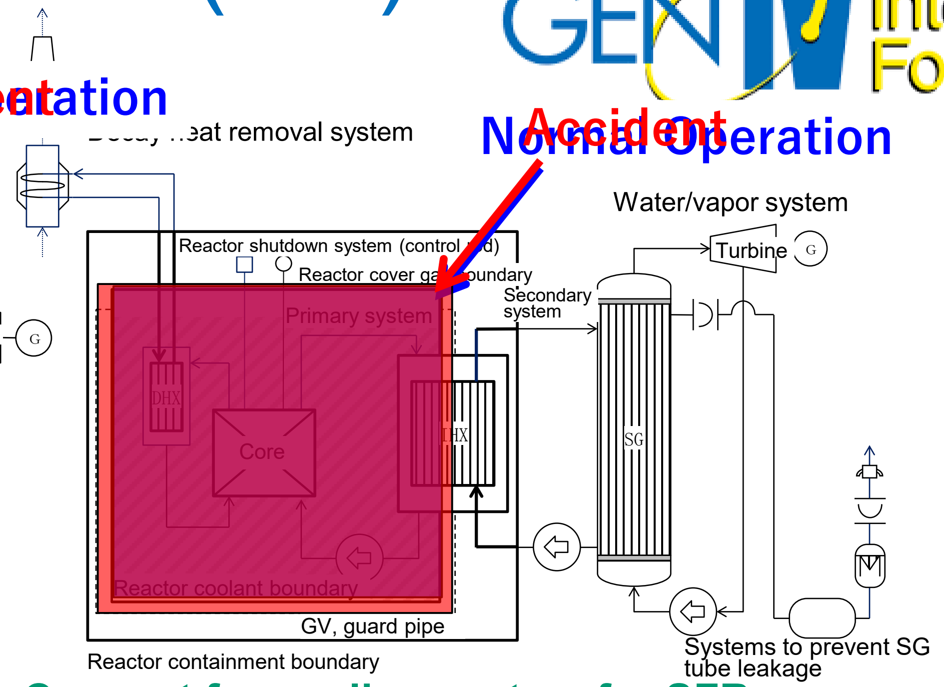
Comparison of LWR and SFR (1/2)

	LWR	SFR
Core and Fuel	• Thermal neutron system • Lower fissile density • Lower fuel burn up	• Fast neutron system • Higher fissile density • Higher fuel burn up
Coolant	• Water ✓ Lower thermal conductivity ✓ Lower boiling point ◆ 100 deg C at atmospheric pressure ◆ 345 deg C at 16 MPa	• Sodium ✓ Higher thermal conductivity ✓ Higher boiling point ◆ 883 deg C at atmospheric pressure ✓ Higher chemical reactivity
System pressure	• High (7 to 16 MPa)	Nearly atmospheric pressure
Environment	• Lower temperature (30 to 350 deg C) • Thermal neutron • Water	• Higher temperature (300 to 600 deg C) • Fast neutron • Sodium

Comparison of LWR and SFR (2/2)



Concept for cooling system for PWR



Concept for cooling system for SFR

	PWR	SFR
Coolant	Water (Chemically stable, transparent, low boiling point)	Na (Chemically active, opaque, activation, high boiling point)
Intermediate loop	Not used	Used (Not to affect to the core in case of Na-water reaction)
Barrier against FP	Reactor coolant pressure boundary	Reactor coolant boundary and reactor cover gas boundary
Decay heat removal	Released to sea water from residual heat removal system through auxiliary cooling system	Released to ambient air through independent Na loop
Coolant leakage	Water injection by emergency core cooling system	Coolant can be maintained by static components, e.g. guard vessels

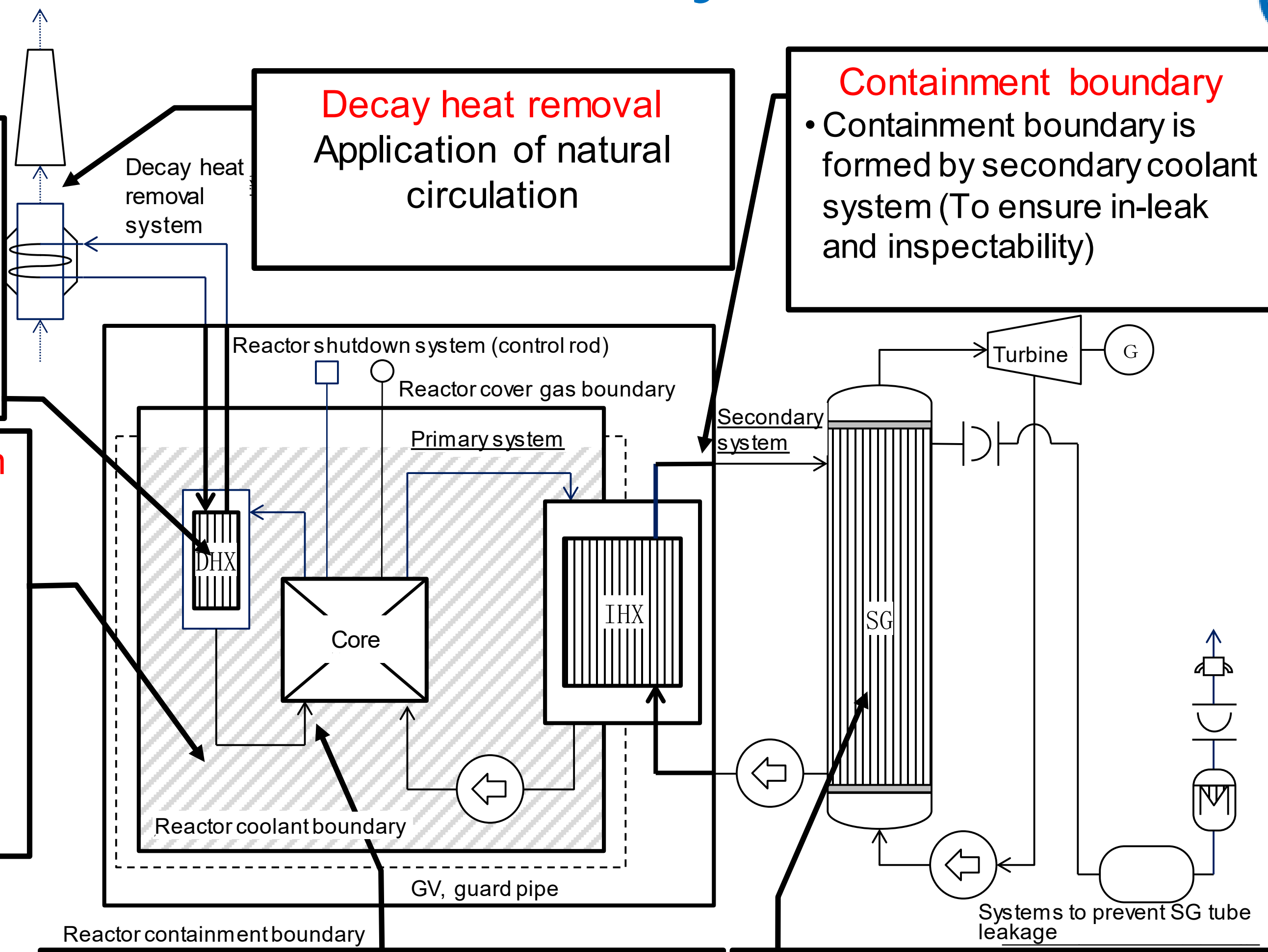
SFR Reactor Coolant System

Operational condition
High temperature, low pressure (Stress due to thermal expansion, creep, temperature change)

Primary coolant system
- Cover gas boundary
- Coolant level maintenance under normal operation
- Coolant level maintenance by GV (& guard pipes)

Decay heat removal
Application of natural circulation

Containment boundary
- Containment boundary is formed by secondary coolant system (To ensure in-leak and inspectability)



Coolant
- Characteristics of Na (High boiling point, risk of freezing, etc.)
- Na leakage prevention and detection

Chemical reaction
Na-water reaction countermeasure (Detection, blow, pressure release, reaction products treatment, etc.)

Safety Characteristics of SFR

Safety advantages of SFR

- Low-pressure coolant system
  - ✓ Guard vessel and guard pipes to maintain coolant inventory
  - ✓ No need of high-pressure injection systems, no risks of loss of coolant accident and control-rod ejection
- Inherent safety features with net negative reactivity feedback
- Large margin to coolant boiling (about 400 deg C) to prevent coolant boiling and core damage
- Dedicated systems for removing decay heat to an ultimate heat sink
  - ✓ Liquid-metal coolant that has excellent thermal conductivity and natural circulation characteristics to facilitate reliance on passive systems
- Low-pressure design (about 0.5 bar) for containment (mainly against heat from a sodium fire)
- Capability to retain non-volatile and some volatile fission products of liquid sodium in core damage situations
- Simple operation and accident management (long grace period for corrective actions)

Safety Characteristics of SFR

Challenges to SFR

- High temperature (> 500 deg C at the core outlet) and high core power density
- Liquid sodium coolant which reacts with air, water and concrete
  - ✓Prevention and mitigation to avoid the effects of the chemical reaction on SSCs (Structures, Systems and Components) important to safety.
- The core is not in its most reactive configuration.
  - ✓For large cores, sodium void worth can be positive.
  - ✓Relocation of core materials under a core damage situation may lead to positive reactivity insertion.
- Opaque sodium coolant could pose challenges to in-service inspection and maintenance.

- Elements to be considered
  - GIF's Safety Goals & Basis for Safety Approach
  - Characteristics of SFR
  - Lesson from Fukushima Daiichi NPPs Accident

Lessons Learned From Fukushima Daiichi NPPs Accident

- Common cause failure caused by external events
- Loss of power for a long period of time
- Decay heat removal, fuel pool cooling
- Containment function on spent fuel in the pool
- Preparing multiple AMs, etc.
- Enhancement of systems that may be needed to decrease the likelihood of a severe accident due to extreme external hazards, the enhancement of response measures against severe accidents, and the reinforcement of the safety infrastructure by ensuring independence and diversity of the safety systems.
- Provisions for handling external events need to be sufficiently robust in coordination with anticipated conditions at the reactor site. For example, the design must consider ensuring power supply during long term loss of all AC power. Enhancing passive safety functions will reduce the dependency on power supplies, and will also be effective as a measure against power loss. As external events, such as earthquakes, tsunami and flooding, may become initiators of severe accidents, necessary protection measures with adequate margins should be provided. Special attention must be paid to water flooding in buildings with sodium equipment.

- Development of SDC and SDGs for Gen IV SFR
  - Safety Design Criteria (SDC)
  - Safety Design Guidelines (SDGs)
    - SDG on Safety Approach
    - SDG on Structures, Systems and Components (SSCs)

Development of the SDC and SDGs for Gen IV SFRs

- "Harmonious" SDC applicable to each country's SFRs are increasingly in demand to
  - enhance the safety of design common to SFR systems, and
  - prepare for the licensing in the near future because the countries are making progress toward the demonstration phase.
- SDC TF members
  - China, EU, France, Japan, ROK, Russia, USA
  - IAEA (observer)
- SDC TF
  - is reflecting feedback in the documents from external authorities such as national regulatory bodies of the countries, IAEA, and OECD/NEA WGSAR
  - participates in GIF-IAEA joint LMFR workshops on safety; and
  - will develop SDC for the other reactor systems through activities of GIF RSWG.

Development of SDC/SDG for GEN IV SFRs

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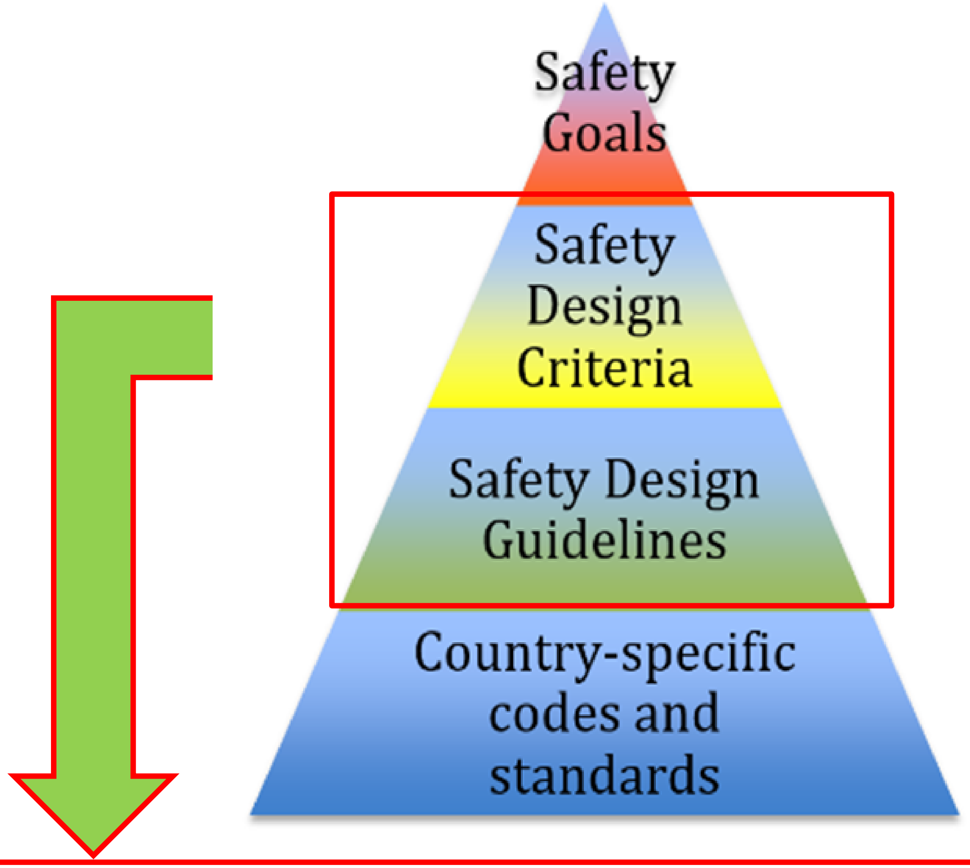


Fundamental safety principles and common safety goals for all Gen-IV systems

A set of criteria reflecting GIF safety approach to achieve harmonized safety requirements of SFR system

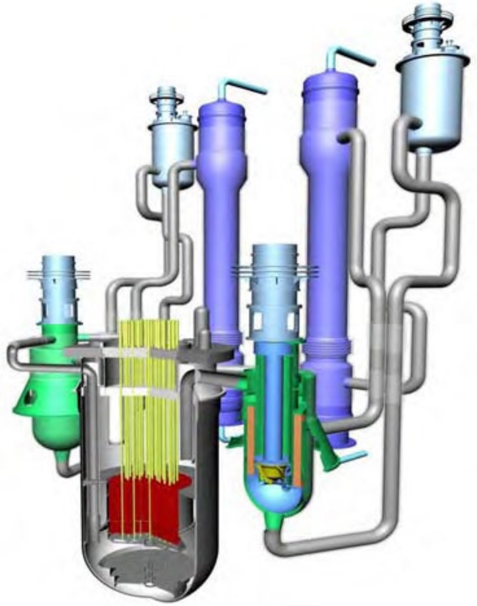
A set of guidelines on how to implement the design criteria and address SFR-specific safety topics

Domestic regulations for design of reactor core, cooling system, and other structures, systems, and components

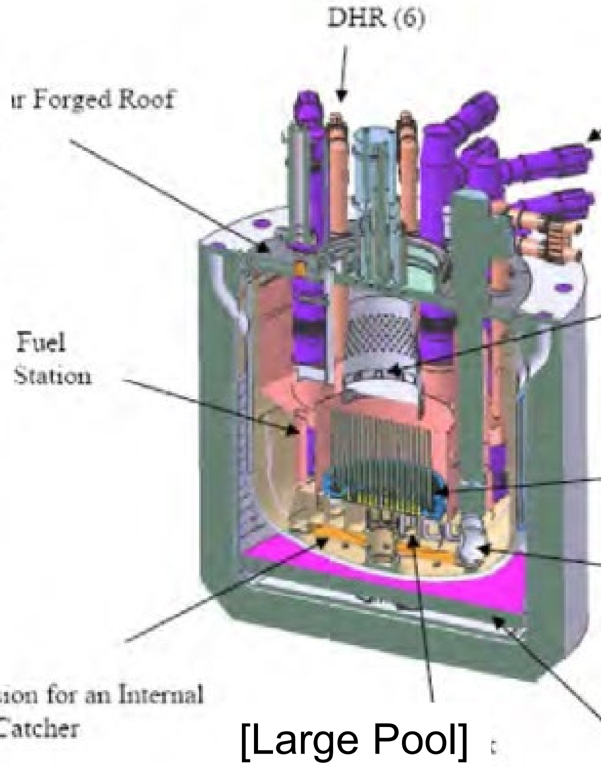
- ***SDC (Phase I report, updated in 2018)***
- ***SDG on Safety Approach and Design Conditions***
- ***SDG on Key Structures, Systems and Components***

SFR Design Options under GIF

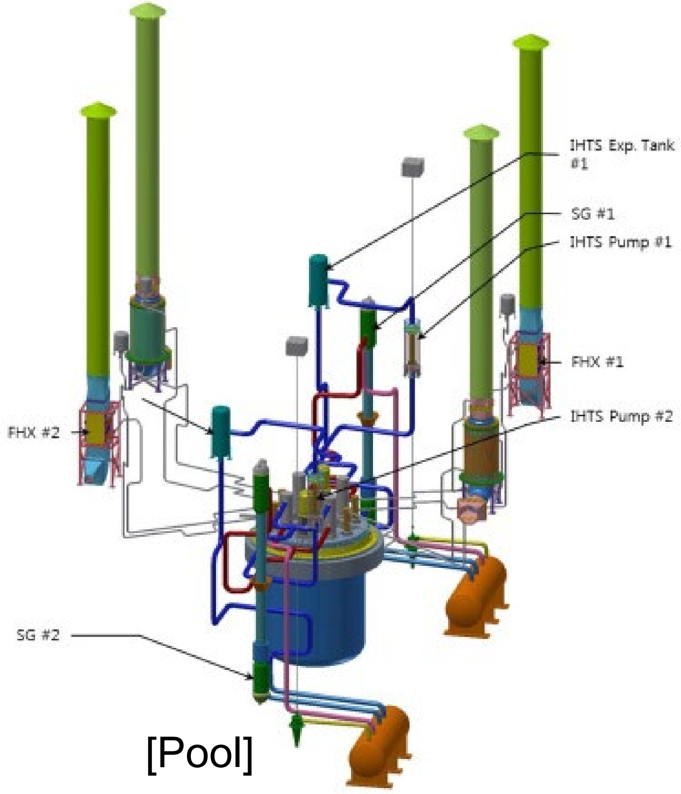
- A large size (600 to 1,500 MWe) loop-type reactor with mixed uranium-plutonium oxide fuel and potentially minor actinides, supported by a fuel cycle based upon advanced aqueous processing at a central location serving a number of reactors
- An intermediate-to-large size (300 to 1,500 MWe) pool-type reactor with oxide or metal fuel
- A small size (50 to 150 MWe) modular pool-type reactor with metal alloy fuel, supported by a fuel cycle based on pyrometallurgical processing in facilities integrated with the reactor



[Large Loop]



[Large Pool]



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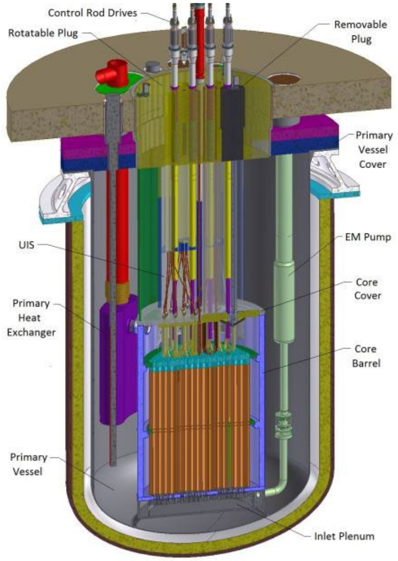

[Small Modular]

SDC and SDGs Development Scheme

Safety Design Criteria (SDC)

[83 criteria, 205 paragraphs]

- Safety Approach as Gen-IV
- SFR Characteristics
- Lesson Learned from 1F accident

Reference

IAEA SSR-2/1 & Safety Glossary

Design Options

- Small Modular to Large
- Oxide fuel, Metal fuel
- Pool-type, Loop-type

Functions and considerations for Design Measures

Design Conditions

- Postulated Initiating Events & Design Limits
- Testability
- Demonstration
- Individual considerations

Common Points

SDG on Safety Approach & Design Conditions

General Approach

- AOO & DBA
- Design Extension Conditions
- Practical Elimination of Accident Situations

Application of SDC

- Reactivity Issue
- Decay Heat Removal Issue

IAEA NS-G Series

- Document Structure
- Interface with associated systems

Reference

SDG on Key SSCs

- Reactor Core
- Reactor Coolant System
- Reactor Containment System

- Development of SDC and SDGs for Gen IV SFR
  - Safety Design Criteria (SDC)
  - Safety Design Guidelines (SDGs)
    - SDG on Safety Approach
    - SDG on Structures, Systems and Components (SSCs)

Scope of SDC

- The objective of the SDC is to present the reference criteria of the safety design of SSCs of the SFR system.
- The criteria are clarified systematically and comprehensively to adopt the GIF's basic safety approach established by the GIF Risk & Safety Working Group, with the aim of achieving the safety and reliability goals defined in the GIF Roadmap.

» ***The revised SDC report (Rev.1) is available on GIF web site.***

(https://www.gen-4.org/gif/jcms/c_93020/safety-design-criteria)

Table-Of-Contents of SDC

SDC-TF/2017/02

Sept. 30, 2017

Safety Design Criteria
for
Generation IV Sodium-cooled Fast Reactor System

(Rev. 1)

Prepared by:

The Safety Design Criteria Task Force (SDC-TF)

Of the Generation IV International Forum

6. DESIGN OF SPECIFIC PLANT SYSTEMS

6.1 Overall Plant System	*Criterion 42bis*
6.2 Reactor Core and Associated Features	*Criteria 43-46*
6.3 Reactor Coolant Systems	*Criteria 47-53*
6.4 Containment Structure and Containment System	*Criteria 54-58*
6.5 Instrumentation and Control Systems	*Criteria 59-67*
6.6 Emergency Power Supply	*Criterion 68*
6.7 Supporting Systems and Auxiliary Systems	*Criteria 69-76bis*
6.8 Other Power Conversion Systems	*Criterion 77*
6.9 Treatment of Radioactive Effluents and Radioactive Waste	*Criteria 78-79*
6.10 Fuel Handling and Storage Systems	*Criterion 80*
6.11 Radiation Protection	*Criteria 81-82*

GLOSSARY

APPENDIX:

(A) Definitions of Boundaries of SFR systems

(B) Guide to Utilization of Passive/Inherent Features

(C) Approach to Extreme External Events


SDC-TF/2017/02

Sept. 30, 2017

Safety Design Criteria
for
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Of the Generation IV International Forum

- Development of SDC and SDGs for Gen IV SFR
  - Safety Design Criteria (SDC)
  - Safety Design Guidelines (SDGs)
    - SDG on Safety Approach
    - SDG on Structures, Systems and Components (SSCs)

Scope of SDG on Safety Approach

- This report is intended to provide recommendations and guidance on how to comply with the SDC. It presents examples for the measures stated in criteria as the best practices to help the designers achieve high levels of safety.
- Initially, the guidelines will focus on specific safety concerns, such as reactivity characteristics of SFRs and heat removal issues.
- To address the potential consequences of such accidents, this report focuses on providing examples of design approaches for "prevention and mitigation of severe accidents" and for "loss-of-decay heat removal capability as a situation that needs to be practically eliminated".
  - » ***The SDG on Safety Approach report is available on GIF web site.***

    (https://www.gen-4.org/gif/jcms/c_93020/safety-design-criteria)

Table-Of-Contents of SDG on Safety Approach

1. INTRODUCTION
   - 1.1. Background and Objectives
   - 1.2. Scope of the Safety Design Guidelines
2. MAIN CHARACTERISTICS OF GEN-IV SFR SYSTEMS
3. GENERAL APPROACH
   - 3.1. Design Basis and Residual Risk
   - 3.2. General Approach to Normal Operation, AOOs, and DBAs
   - 3.3. General Approach to Design Extension Conditions
   - 3.4. Design Considerations for Design Extension Conditions
   - 3.5. Practical Elimination of Accident Situations
4. GUIDELINES FOR APPLICATION OF SAFETY DESIGN CRITERIA
   - 4.1. Reactivity Issues
   - 4.2. Decay Heat Removal Issues
   - 4.3. Postulated Initiating Events and Design Limits
   - 4.4. Testability
   - 4.5. Demonstration
5. CLARIFICATION AND QUANTIFICATION OF TECHNICAL POINTS CONCERNING SAFETY DESIGN CRITERIA
   - 5.1. Consideration concerning SFR Reactivity Characteristics

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SDC-TF/2016/01

March 04, 2016

Safety Design Guidelines

on

Safety Approach and Design Conditions

for

Generation IV Sodium-cooled Fast Reactor Systems

Prepared by:

The Safety Design Criteria Task Force (SDC-TF)

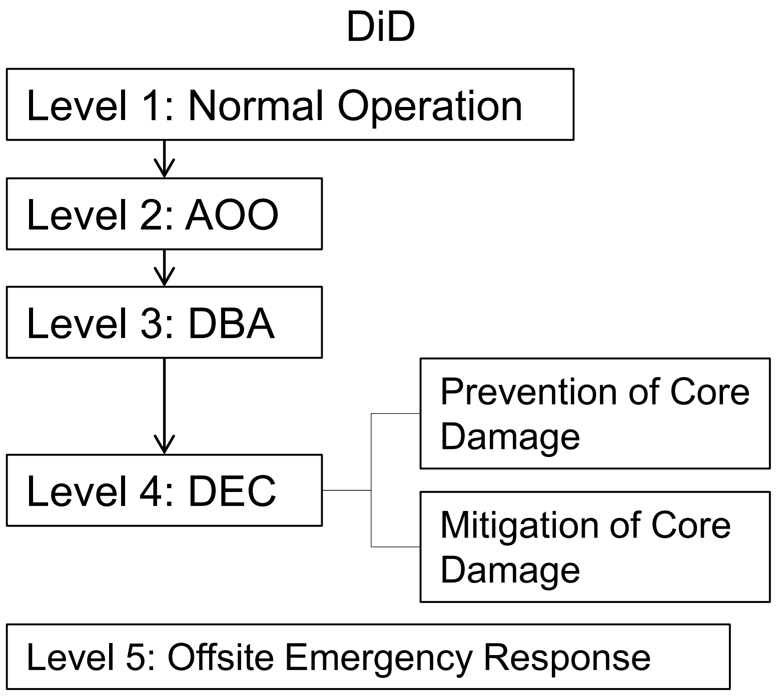
of the Generation IV International Forum

General Design Approach

- Safety is primarily based on the use of multiple redundant engineered safety features to lower the probability of accidents and to limit the consequences of anticipated operational occurrences and design basis accidents.
- These safety features include independent and diverse scram systems, multiple coolant pumps and heat transport loops, decay heat removal systems, and multiple barriers against release of radioactive materials.
- In addition to these features, passive/inherent features for cooling and shutdown/power reduction may also play a significant role in the safety performance of Gen-IV SFRs by improving the diversity of safety systems.

General Approach to Normal Operation, AOOs, and DBAs

- Normal Operation- Stable operation, with controlling reactivity, temperature, flow…
- AOOs/DBAs- Shutdown the reactor and maintain decay heat removal sufficient to keep reactor core and system temperatures within the applicable design limits.



General Approach to Design Extension Conditions

- Prevention of Core Damage
  - Accident sequences typically caused by failure of one or more systems related to safety
  - Postulated initiating events more severe than those in DBA
- Mitigation of Core Damage
  - Mitigation of consequences of postulated accidents where significant core damage may occur, with the objective of maintaining the containment function to limit radioactive releases.

Typical AOOs and DBAs for SFRs

Challenge	Mechanism	Typical initiating events	
		AOO	DBA
Imbalance of core power and cooling	Core power increase	• Erroneous withdrawal of control rod (normal speed) • Control rod drop	• Erroneous rapid withdrawal of control rod • Gas bubble passage
	Primary coolant flow decrease	• Loss of external power • Primary pump trip	• One primary pump seizure • Primary coolant pipe failure (In-vessel pipe for pool type)
	Abnormality in heat sink	• Secondary pump trip • Feedwater pump trip • Loss of load • Small leak of steam generator heat exchanger tube	• One secondary pump seizure • Secondary coolant pipe breach • Main feedwater or steam pipe rupture • Heat exchanger pipe rupture on steam generator

Design Approach to DECs (1/2)

Exploiting SFR Characteristics to Enhance Safety

- Passive or Inherent safety for DEC
  - Reactivity control
    - Inherent reactivity feedback to reduce the power as core temperatures rise or
    - Passive mechanism are applicable for shutdown systems, such as SASS, HSR, and GEM
  - Decay heat removal
    - Natural circulation of single phase sodium coolant
    - Various configurations for enhancing diversity, such as DRACS, PRACS, and RVACS

Design Approach to DECs (2/2)

Exploiting SFR Characteristics to Enhance Safety

- In-Vessel Retention
  - Safety design strategy aimed at ensuring long-term retention of core materials inside the RV for any accident situation, including those resulting in degradation or loss of core integrity, by providing coolability of the core materials under sub-critical conditions
  - Typically accomplished by providing the means to keep the core submerged under the sodium coolant and the decay heat removal paths available

Practical Elimination of Accident Situations (1/2)

IAEA's terminology

'practically eliminated' was used in requirements for the design of nuclear power plants to convey the notion that the possibility of the potential occurrence of certain hypothetical event sequences in scenarios could be considered to be excluded…

Application to Design

- Situations, which may lead to early or large radioactive release and which cannot be mitigated under acceptable conditions, are identified to be practically eliminated by implementation of design provisions.
- The approach is intended to demonstrate that the identified situation is physically impossible by design, or that implemented provisions eliminates the situation to a residual risk with a high degree of confidence.
- Practical elimination can be considered as part of a general approach and as an enhancement of the Defence-in-Depth principle. The design should restrain practical elimination to a very limited list of situations.

Practical Elimination of Accident Situations (2/2)

Example of situations

- Severe accidents with mechanical energy release higher than the containment capability
  - Power excursions for intact core situations
    - Large gas bubble through the core
    - Large-scale core compaction
    - Collapse of the core support structures
- Situations leading to the failure of the containment with risk of fuel damage
  - Complete loss of decay heat removal function that leads to core damage and failure of primary coolant boundary
  - Core uncovering due to sodium inventory loss
- Fuel degradation in fuel storage or during when the containment may not be functional due to maintenance
  - Core damage during maintenance
  - Spent fuel melting in the storage

- Development of SDC and SDGs for Gen IV SFR
  - Safety Design Criteria (SDC)
  - Safety Design Guidelines (SDGs)
    - SDG on Safety Approach
    - SDG on Structures, Systems and Components (SSCs)

Scope of SDG on SSCs

- To provide detailed guidelines for SFR designers to support the practical application of the SDC in design process to ensure the highest level of safety in SFR design.
- To show recommendations and guidance to comply with the SDC and the Safety Approach SDG with examples, which can be applied to Gen-IV SFR systems in general.
- The GIF SDC TF expects that these recommendations and examples will be appropriately considered in design according to each design characteristic.

Table-Of-Contents of SDG on SSCs (1/2)


SDC-TF/2018/01

April 25, 2018

Safety Design Guidelines

on

Structures, Systems and Components

for

Generation IV Sodium-cooled Fast Reactor Systems

[Draft version 0, dated April 25, 2018]

Prepared by:

The Safety Design Criteria Task Force (SDC-TF)

of the Generation IV International Forum

Table-Of-Contents of SDG on SSCs (2/2)

I. APPENDIX

- I.1. Fuel Characteristics (oxide, metal, and nitride fuels)
- I.2. Mechanical Design of Fuel Assemblies
- I.3. Reactivity Coefficient
- I.4. Sodium-Water Reaction
- I.5. Decay Heat Removal System
- I.6. Configuration Examples of Isolation Valves

II. ANNEX

- II.1. Active Reactor Shutdown System
- II.2. Passive Reactivity Mechanisms
- II.3. Configurations and Measures for Sodium Leakage and Combustion
- II.4. Design Measures Against Sodium-Water Reaction
- II.5. Containment Structures

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SDC-TF/2018/01

April 25, 2018

Safety Design Guidelines

on

Structures, Systems and Components

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Focal Points Featuring SFR Characteristics

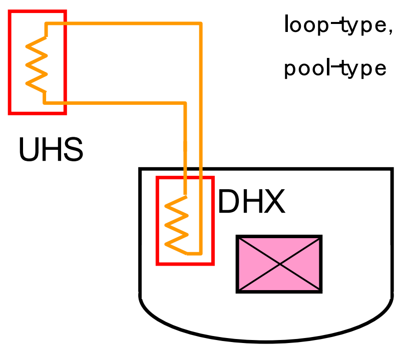
Systems	Safety features	Focal points	SDC	SDG on Safety Approach
Reactor Core systems	Integrity maintenance of core fuels	1. Fuel design to withstand high temperature, high inner pressure, and high radiation conditions	✔	
		2. Core design to keep the core coolability	✔	✔
	Reactivity control	3. Active reactor shutdown	✔	✔
		4. Reactor shutdown using inherent reactivity feedback and passive reactivity reduction	✔	✔
		5. Prevention of significant energy release during a core damage accident, In-Vessel Retention	✔	✔
Coolant systems	Integrity maintenance of components	6. Component design to withstand high temperature and low pressure conditions	✔	
	Primary coolant system	7. Cover gas and its boundary	✔	
		8. Measures to keep the reactor level	✔	✔
	Measures against chemical reactions of sodium	9. Measures against sodium leakage	✔	
		10. Measures against sodium-water reaction	✔	
	Decay heat removal	11. Application of natural circulation of sodium	✔	✔
		12. Reliability maintenance (diversity and redundancy)	✔	✔
Containment systems	Design concept and load factors	13. Formation of containment boundary and loads on it	✔	
	Containment boundary	14. Containment function of secondary coolant system	✔	

Decay Heat Removal System

DRACS

Direct Reactor Auxiliary Cooling System

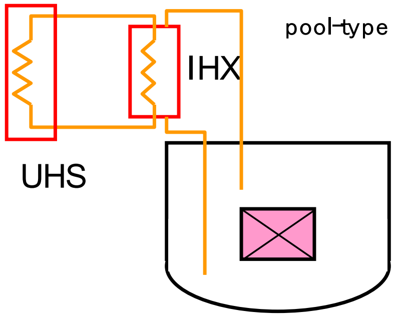
loop-type, pool-type



RACS

Reactor Auxiliary Cooling System

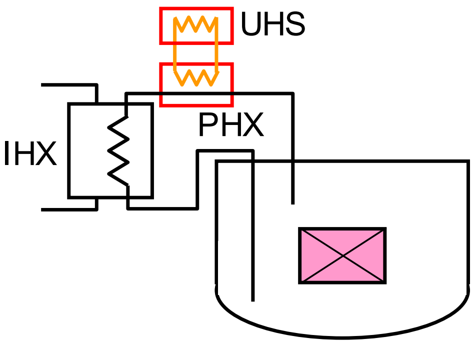
loop-type, pool-type



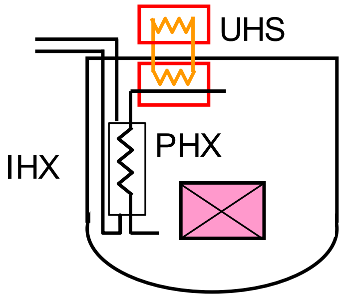
PRACS

Primary Reactor Auxiliary Cooling System

loop-type



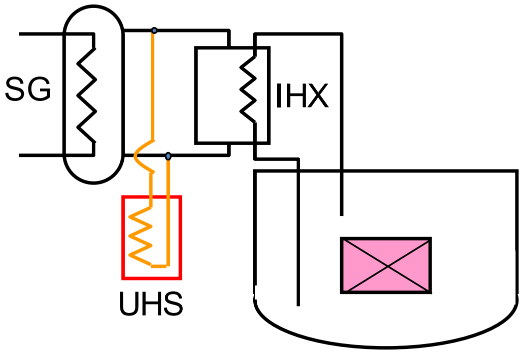
pool-type



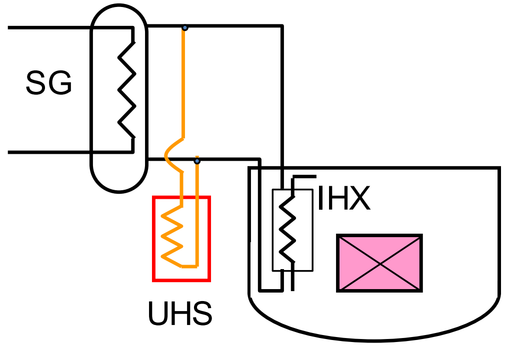
IRACS

Intermediate Reactor Auxiliary Cooling System

loop-type



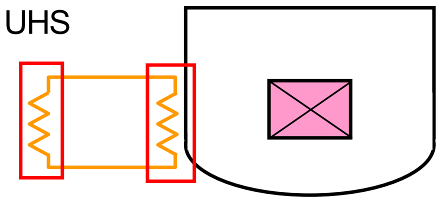
pool-type



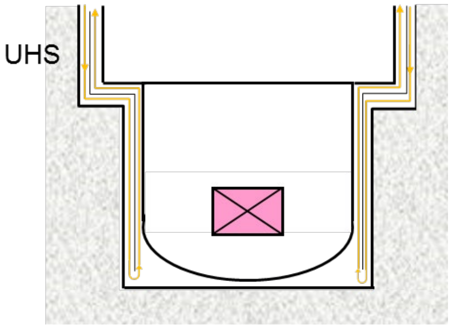
RVACS

Reactor Vessel Auxiliary Cooling System

loop-type, pool-type



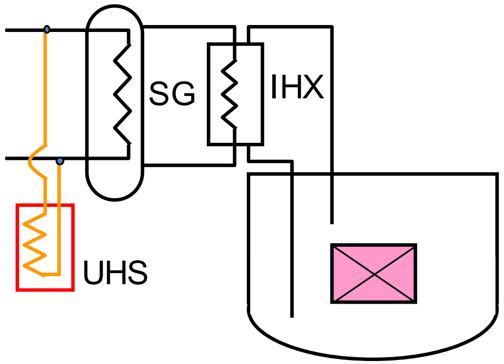
loop-type, pool-type



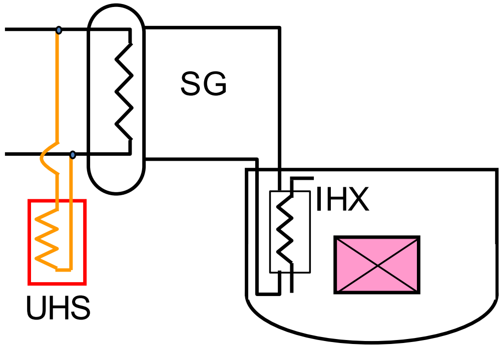
SGACS

Steam Generator Auxiliary Cooling System

loop-type



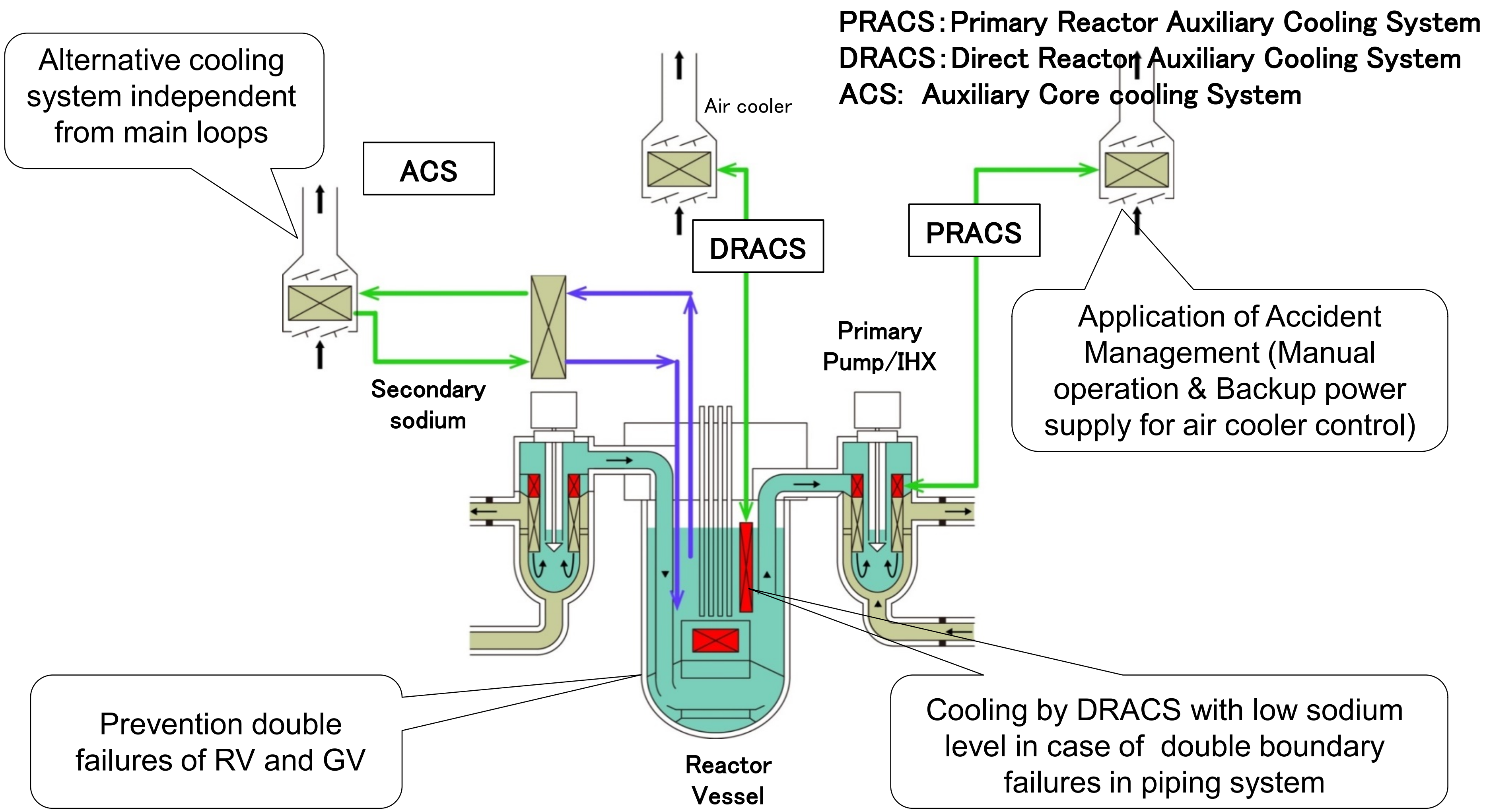
pool-type



DHX：heat exchanger of DRACS　IHX：intermediate heat exchanger　PHX：heat exchanger of PRACS　SG：steam generator　UHS：ultimate heat sink
Orange and red lines show decay heat removal systems.

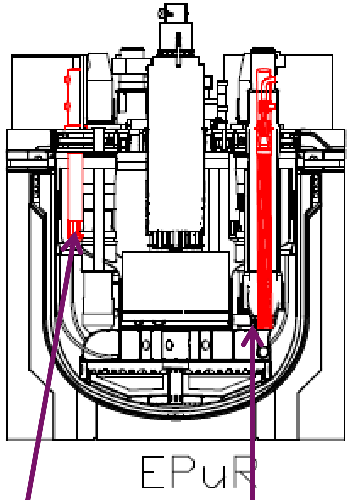
Decay Heat Removal System

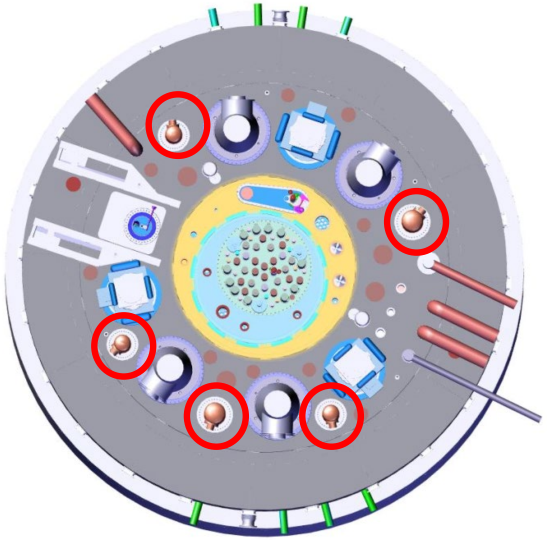
JSFR

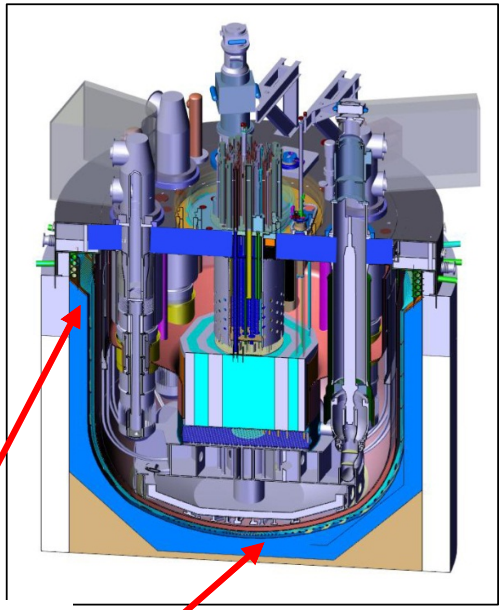


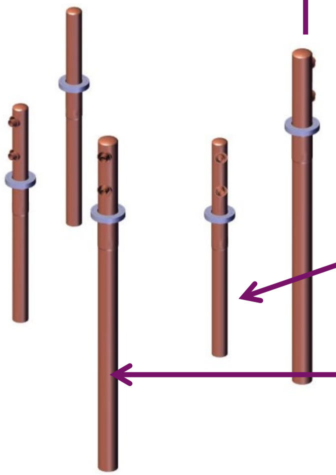
Decay Heat Removal System

ASTRID



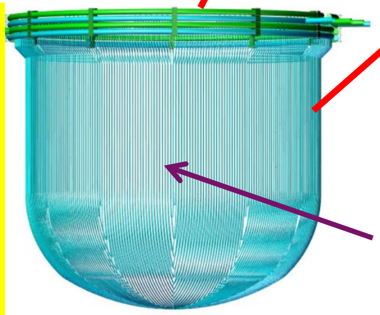






2 diversified in-vessel decay heat removal systems

- Passive in the hot reactor plenum (3 trains x66%)
- Active in the cold reactor plenum (2 trainsx100%)
- Na coolant
- Air heat sink

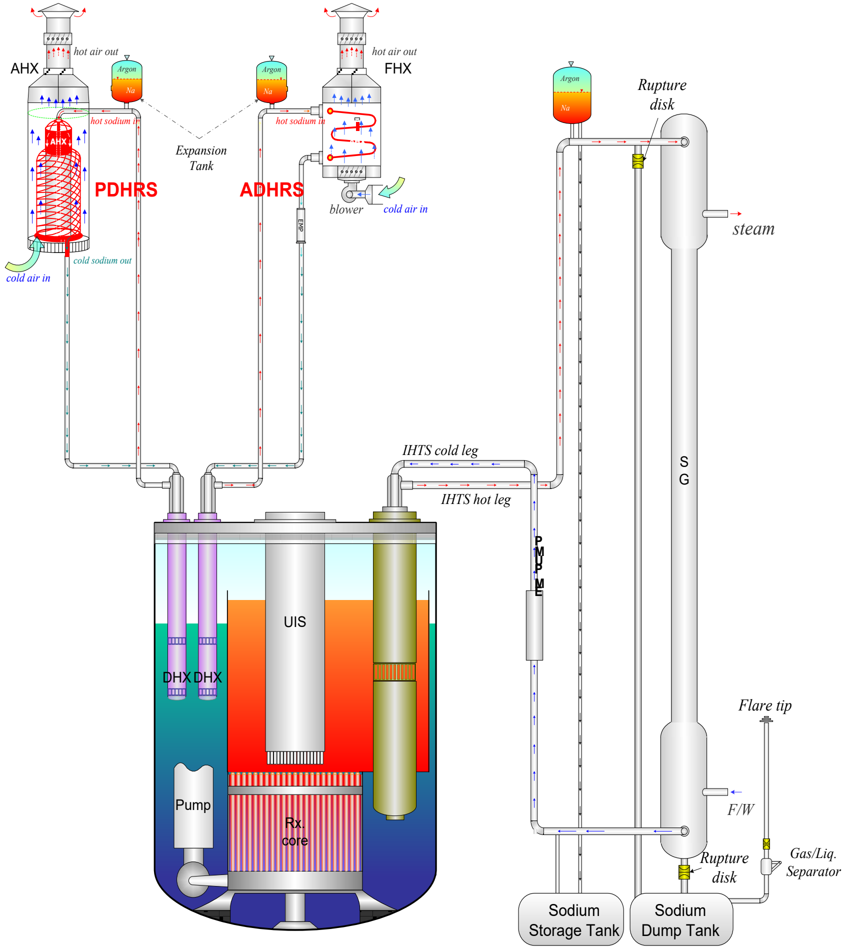


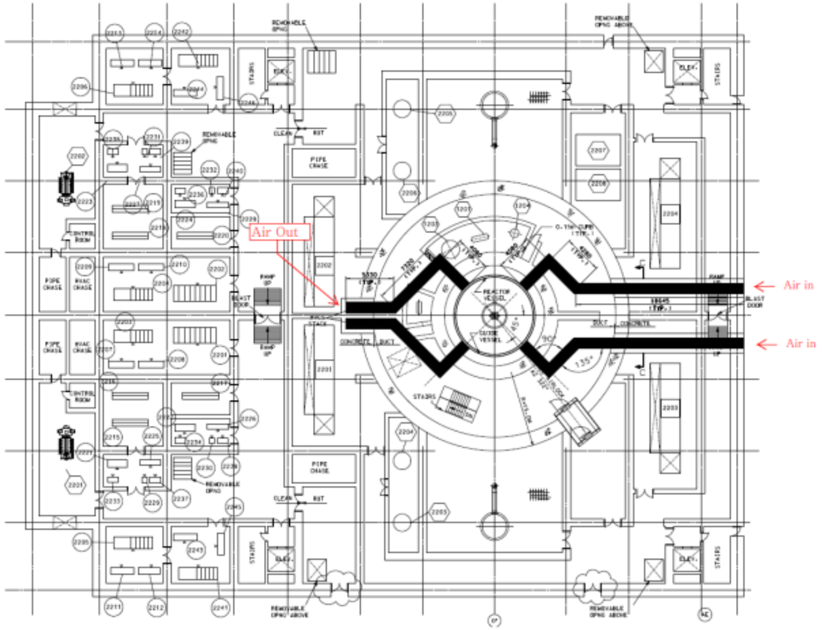
Third heat removal system through reactor vessels for severe accidental conditions

- Oil coolant
- Water heat sink

Decay Heat Removal System

PGSFR





Concluding Remarks

- As part of development of Gen IV reactor systems, GIF is developing the SDC that can be applied worldwide and the SDGs that show how to apply the SDC to actual design, considering safety goals and design policies of Gen IV reactor systems, safety characteristics as well as lessons learned from Fukushima Daiichi NPP accident.

- GIF has developed the SDC and two SDGs for SFRs.

- GIF is making efforts in reflecting feedback in the documents from external bodies and participating in activities such as GIF-IAEA joint workshops so that the SDC and SDGs can be applied worldwide.

- GIF will develop SDC and SDGs for the other reactor types.

Upcoming Webinars

26 March 2020	MicroReactors: A Technology Option for Accelerated Innovation	Dr. DV Rao (LANL), USA
29 April 2020	GIF VHTR Hydrogen Production Project Management Board	Dr. Sam Suppiah, CNL, Canada
28 May 2020	Performance assessments for fuels and materials for advanced nuclear reactors	Prof. Daniel LaBrier, ISU, USA