GEN IV International Forum[SM]

Expertise | Collaboration | Excellence

Generation IV International Forum (GIF):

Developing the nuclear energy systems of the future

GIF is developing six advanced nuclear reactor concepts under four special missions below

- Regulatory mission
- Market Opportunities and Challenges mission
- Enhancement of R&D collaboration mission
- Education and training especially for young generation

Sodium-cooled Fast Reactor(SFR), Lead-cooled Fast reactor(LBR)
Very High Temperature Reactor (VHTR), Gas-cooled Fast Reactor(GFR)
Supercritical Water-cooled Reactor(SCWR), Molten Salt Reactor (MSR)

See: **https://www.gen-4.org/gif/jcms/c_59461/generation-iv-systems**

Representatives from Australia, Canada, France, Japan, China, Korea, Russia, South Africa, Switzerland, the United Kingdom, the United States and Euratom

Sustainable, safe, clean, reliable, flexible and affordable energy source for the future

GIF Mission

The Generation IV International Forum (GIF) is a co-operative international endeavour set up to carry out the research and development (R&D) needed to establish the feasibility and performance capabilities of **the next generation nuclear energy systems**.

The GIF has 14 members which are signatories of its founding document, the GIF Charter. R&D cooperation is carried out by 12 of its members, who have signed or acceded to the Framework Agreement, an international treaty overseeing the work of GIF.

The GIF goals provided the basis for identifying and selecting **six nuclear energy systems for further development. The selected systems are based on a variety of reactor, energy conversion and fuel cycle technologies.** Their designs include thermal and fast neutron spectra cores, closed and open fuel cycles. The reactors range in size from very small to very large. Depending on their respective degree of technical maturity, the first Gen IV systems are expected to be deployed commercially around 2030-2040.

In light of the ambitious nature of the goals involved, international cooperation is considered essential for a timely progress in the development of Generation IV systems. This cooperation makes it possible to pursue multiple systems and technical options concurrently and to avoid any premature down selection due to the lack of adequate resources at national level.

As the International Energy Agency foresees, **flexibility will be the cornerstone of tomorrow's energy systems**. This can come from various generation technologies, grid infrastructures and storage systems. Nuclear systems, and advanced reactors such as Gen IV systems, can contribute to this required flexibility, in terms of operational flexibility (load following, heat storage), deployment flexibility (scale, siting) or product flexibility (electricity and non-electric applications, such as process heat, hydrogen production or desalination). This is being discussed in many symposiums and workshops like CEM Nuclear Innovation: Clean Energy Future (NICE Future), and widely gaining consensus.

According to Mr Hideki KAMIDE, current GIF Chair: “We have roadmaps to develop Gen IV advanced nuclear systems and methodologies to assess their compliance to the GIF goals. We will also need to show how these advanced nuclear technologies can integrate into and support future clean energy systems.”

Former GIF Chair Mr François GAUCHE (France) and Current Chair Mr Hideki KAMIDE (Japan) at the GIF Symposium in Paris (Oct 2018).

Current priorities of GIF:

- **Continue the development of international safety design criteria to facilitate future licensing activities**
- **Integration of Gen-IV systems (flexibility, economics) and renewable energy systems in clean energy systems**
- **Enhancement of international R&D collaboration**
- **Attract the young generation**

Mr. Hideki KAMIDE emphasized that “International cooperation is extremely essential for the present era to pursue multiple GIF advanced nuclear systems and technical options concurrently and to avoid any premature down selection due to the lack of adequate resources at the national level” in front of JAEA R&D facility, PHEASANT.

Regulatory Mission

Alice Caponiti (USA, DOE)

GIF PG Vice-Chair:

Alice Caponiti is the Director of Department of Energy's Office of Nuclear Energy Technologies, which provides strategic direction and execution of nuclear energy programs to improve research infrastructure and industry access to various fields.

The mission of the Vice-Chair on regulatory issues is to **coordinate GIF's activities with various regulatory bodies to harmonize regulatory requirements**. Dialogue between international R&D communities and regulatory communities can facilitate the development of collaborative approaches that

- identify and resolve key regulatory issues,
- identify and address the need of safety research, and
- further harmonize design, safety, and regulatory requirements.

The tasks of the Vice Chair include promoting **Safety Design Criteria (SDC) and Safety Design Guideline (SDG)** for GEN IV Systems and working on **IAEA Safety Standards.**

The Vice Chair also leads GIF's engagement with the **OECD/NEA Working Group on the Safety of Advanced Reactors** (WGSAR) and with appropriate IAEA departments.

Regulatory Mission:

- **Identify need of safety research,**
- **further harmonizing design, safety, and regulatory requirements.**

Risk & Safety Working Group

RSWG developed

- Integrated Safety Assessment Methodology (ISAM)
- White papers on ISAM implementation & safety systems

See: https://www.gen-4.org/gif/jcms/c_9366/risk-safety

Proliferation Resistance & Physical Protection Working Group

PRPPWG developed

- Methodology used to evaluate and facilitate the introduction of PRPP through a case study at the earliest possible stage of design
- PRPP white papers on the six GIF systems with SSCs.

See: https://www.gen-4.org/gif/jcms/c_9365/pr-pp

Safety Design Criteria Task Force

SDC TF developed

- Safety design criteria and guidelines for SFRs reviewed by IAEA, WGSAR, and international regulators .

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

Market Opportunities and Challenges Mission

Sylvestre Pivet (France, CEA)

GIF PG Vice-Chair:

Sylvestre Pivet is the director of the Innovation and Nuclear Support Division which manages the R&D programs led by the CEA in the field of civilian nuclear energy, covering fuel cycle, and advanced and operating reactors and simulation.

Decarbonization of hybrid energy systems is one of the important topics of Market Opportunities and Challenges. In the future, low-carbon or renewable energy systems will increase the global share in the overall energy mix and need to be complemented by energy storage and dispatchable energy technologies. **Decarbonized hybrid energy derived from Gen IV energy systems** can serve as both low-carbon sources of electricity and heat for industrial and other applications.

The Vice Chair addresses how Gen IV systems should deal with the need and challenge of future energy markets and support the development of innovative reactor concepts **in cooperation with external GIF stakeholders, such as private sectors, policy makers, and investors, and various GIF bodies** such as Systems Steering Committees, Economic Modelling Working Group, and Senior Industrial Advisory Panel.

Market Opportunities and Challenges Mission:

Economic Modelling Working Group

EMWG developed

- Free **cost evaluation software G4ECONS** used to estimate six reactor systems economics
- Guidelines for estimating costs and identifying cost drivers of Gen IV designs

See: https://www.gen-4.org/gif/jcms/c_9364/economics Including "Cost Estimating Guidelines" & "Impact of Increasing Share of Renewables"

Senior Industry Advisory Panel

SIAP strategically reviews

- R&D progress and plans of individual systems from the **industry perspective**
- R&D progress and plans of cross-cutting activities (GIF working groups)
- system deployment and future nuclear energy fuel cycles
- international framework for nuclear safety standards and regulations.

The Vice Chair also coordinates activities of GIF and other multilateral initiatives of international organizations such as IAEA INPRO, NEA IFNEC, NEA NI2050. This coordination can contribute **to further investigating and assessing costs and values of, the roles of private sectors for deploying, and to adjust the policy to develop, Gen IV systems**.

Enhancement of R&D Collaborations Mission

Jong-Hyuk Baek (Republic of Korea, KAERI)

GIF PG Vice-Chair:

Jong-Hyuk Baek is a senior vice president(CTO, Chief Technology Officer) for Innovative Nuclear Reactor Systems at Korea Atomic Energy Research Institute.

GIF has been concerned about the R&D collaboration among 6 Gen IV nuclear systems. The mission of the Vice-Chair is to enhance the R&D collaboration within GIF and external organizations. The Vice-Chair with the support of RD TF and AMME TF lead the GIF members to

- ***better understand*** *the drivers, opportunities, and constrains in using large scale facilities for qualification purposes,*
- *examine various means for* ***sharing such resources and R&D results*** *to optimize joint research and shared results, and*
- ***investigate other R&D topics*** *(or crosscutting issues) related especially* ***to research challenge or technical gaps*** *to further boost the development of GEN-IV reactor systems.*

The Vice-Chair points out that it is important to know what makes difficulty in collaborating with others and how we can find the practical solutions.

Enhancement of R&D Collaboration

Mission Focus

- ✓ Strengthening R&D collaboration within GIF
- ✓ Sharing innovative technical idea and issues among the GIF members
- ✓ Promoting collaboration with outside organizations and technology fields

R&D Infrastructure **T**ask **F**orce

RD TF determines

- ➢ technological gaps to be filled,
- ➢ R&D infrastructure needed to fill the gaps, and
- ➢ **promote the use of experimental facilities for collaborative R&D activities**

Advanced **M**anufacturing / **M**aterials **E**ngineering **T**ask **F**orce

AMME TF identities

- ➢ the interest of both research institutions and nuclear companies in a crosscutting activities and
- ➢ **collaboration ways to reduce the time and cost for deployment of Gen IV reactor systems**

Recent GIF activity

- ✓ **Generation –IV Systems' Experimental Infrastructure Needs**
- ✓ **GIF Workshops with Nuclear Industry including SMR vendors and supply chains**:

Find out more information in : *https://www.gen-4.org/gif/*

Education and training especially for young generation

GIF-Education and Training Task Force (ETTF) was launched in 2015 to serve as a platform to enhance open education and training (E&T) as well as communication and networking of people and organizations in support of Gen IV International Forum.

The principal objectives of the task force:

1) identifying and advertising current training courses,
2) identifying and engaging collaboration with other international E&T organizations,
3) developing webinar series dedicated to Gen IV systems and related cross-cutting topics and advertising these at the national and international level,
4) creating and maintaining a modern social medium platform (- such as **LinkedIn https://www.linkedin.com/groups/8416234**) to exchange information and ideas on GIF Research and Development (R&D) topics.

To watch GIF Webinar, Just visit our site!
https://www.gen-4.org/gif/jcms/c_84279/webinars

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