



Joint IAEA-GIF Technical Meeting/Workshop on Safety of Sodium-Cooled Fast Reactors

**IAEA Headquarters¹
Vienna, Austria**

10-11 June 2014

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TERMS OF REFERENCE

1. BACKGROUND

Sodium-cooled Fast reactors (SFR) have been brought in the last decades to a high level of maturity through the design, construction and operation of experimental and prototype reactors, such as the Fast Flux Test Facility (FFTF) in USA, the small size Prototype Fast Reactor (PFR) in the United Kingdom, the prototype PHÉNIX in France, the BN-350 in Kazakhstan, the demonstration plant BN-600 in Russia, JOYO and MONJU in Japan, the commercial size SUPERPHÉNIX in France, etc.

Several countries are currently engaged in SFR design and construction projects. In China, the 65 MW(th) (20 MW(e)) China Experimental Fast Reactor (CEFR) reached criticality for the first time on 25 July 2010 and was connected to the grid on 21 July 2011. Fast reactors commercialization in China will follow with the realization of the demonstrative plant CFR-600 expected to be developed also thanks to international collaborations. The construction of the India's 500 MW(e) Prototype Fast Breeder Reactor (PFBR) at Kalpakkam is expected to be completed this year. Taking advantage of the feedback experience gained from the design, construction and safety review of the PFBR, the Indian programme for fast reactors deployment foresees the construction of FBR-1 & 2 units around 2023-2024, and the

¹ The specific venue is Room VIC M7 in the Vienna International Centre.

development of the future FBRs with metallic fuel and higher breeding ratio beyond 2025. In the Russian Federation, which operates in Beloyarsk the currently most powerful commercial fast reactor BN-600, the BN-800 is expected to reach first criticality this year. Russian Federation has also launched the Federal Target Programme "New generation nuclear power technologies for 2010-2015 with outlook to 2020" aimed, in particular, at the development of the advanced SFR BN-1200, as well as the new Multipurpose Research Na-cooled Fast Reactor called MBIR. Under its Strategic Energy Technology Plan (SET-Plan), Europe has defined in 2010 the technological pathway for developing fast neutron reactors, which includes the SFR concept as a first track aligned with Europe's prior experience. The related demonstration and implementation programme ESNII (European sustainable nuclear industrial initiative) foresees the realization in France of the GEN-IV SFR prototype called ASTRID. Japan has been developing the 1500 MW(e) GEN-IV JSFR (Japan sodium-cooled fast reactor) in the frame of its Fast Reactor Cycle Technology (FaCT) project; in parallel Toshiba is conducting the detailed design and the safety analysis of its small size 4S concept. Republic of Korea is carrying out a broad R&D programme in support of the development of the Prototype GEN-IV Sodium-cooled Fast Reactor (PGSFR). Finally, in the USA GE-Hitachi is continuing the development of its 311 MW(e) PRISM modular SFR, and TerraPower is a Travelling Wave Reactor-Prototype (TWR-P) cooled by sodium.

Besides the mentioned national projects, relevant international initiatives have been established in the last years in order to promote cooperation among countries with development and deployment programmes on innovative SFRs. The most relevant are the ones carried out under the auspices of the Generation IV International forum (GIF) and the International Atomic Energy Agency (IAEA), which have jointly committed to collaboration between the programmes and to share information in selected areas of mutual interest. One of the key areas of emphasis in both the GIF and the IAEA programmes is the safety of SFR and in particular the harmonization of safety approach, safety requirements and safety design criteria for the GEN-IV SFRs (SDC_SFR) under development worldwide. This topic has gained an increased importance in the aftermath of the accident that occurred in 2011 at the Fukushima Dai-ichi NPP, which has drawn renewed attention on nuclear safety and on the importance of an international safety framework for reactors currently in operation as well as new designs.

In the framework of this collaboration, a series of joint IAEA-GIF Workshops on "Safety aspects of Sodium-cooled fast reactors" has been held since 2010. The first joint IAEA-GIF SFR workshop, titled "Operational and Safety Aspects of Sodium-Cooled Fast Reactors" was held on 23-25 June 2010 at the IAEA headquarters. This was followed by a second Workshop titled "Safety Aspects of Sodium-cooled Fast Reactors", held on 30 November-1 December 2011. In 2012, the IAEA organized also the following other events on safety of SFR:

- Technical Meeting on Impact of the Fukushima event on current and future fast reactor designs, Dresden (Germany), 19-23 March 2012;
- IAEA/JAEA International Workshop on prevention and mitigation of severe accidents in Sodium-cooled Fast Reactors", Tsuruga (Japan), 11-13 June 2012.

A third joint IAEA-GIF Workshop on "Safety Design Criteria for Sodium-Cooled Fast Reactors" was held on 26-27 February 2013. The outcomes of this Workshop were discussed also during the "International Conference on Fast Reactors and Related Fuel Cycles: Safe Technologies and Sustainable Scenarios (FR13)", Paris, 4-7 March 2013, which included a

specific track on “Fast reactor safety: post-Fukushima lessons and goals for next-generation reactors” and a panel on “Safety Design Criteria”.

The development of the SDC_SFR was initiated by the GIF Policy Group (PG) in 2011 in order to harmonize safety requirements among the design organizations represented within GIF, and to quantify the high level of safety expected for GEN-IV systems. The SDC_SFR, derived from the Generation IV programme goals and developed consistently with the structure of the IAEA safety standards, have been compiled into a Phase 1 Report first presented and discussed at the above mentioned IAEA-GIF Workshop in February 2013, and then issued by GIF in May 2013.

The GIF PG in July 2013 decided to invite the Regulators from GIF Member States and some International Organizations (IAEA, NEA, MDEP) to review the Phase 1 Report, and to proceed with a Phase 2 work intended to quantify the SDC_SFR and to develop detailed guidelines to implement the general criteria.

Meanwhile, the GIF and the IAEA have agreed to invite design organizations of innovative SFRs currently under development, with the aim to present engineering solutions able to meet the SDC_SFR.

In order to discuss these topics, and following the recommendations provided by the participants in the third IAEA-GIF Workshop, a fourth joint IAEA-GIF Workshop on safety of SFR is organized by the IAEA and planned to be held in Vienna on 10-11 June 2014.

2. PURPOSE

The main purpose of the fourth Joint GIF – IAEA Technical Meeting/Workshop on Safety of Sodium-Cooled Fast Reactors is to present and discuss the following topics:

- Status of the SDC_SFR Phase 1 Report review by national Regulators and International Organizations (IAEA, NEA, MDEP);
- Implementation of current SDC_SFR by the designers of innovative SFRs concepts: examples of designers’ engineering solutions to SFR safety design criteria;
- Status of SFR_SDC Phase 2 development: design criteria quantification, development of detailed guidelines to implement general criteria;
- Technical discussion on specific safety design criteria: practical elimination of accident situations, design extension conditions, sodium void reactivity effect.

3. TARGET AUDIENCE

The target audience for this meeting comprises:

- Representatives of GIF countries signatories of the system arrangement for the SFR system;
- GIF Technical Director, representatives of the SFR Task Force on Safety Design Criteria, and other SFR safety experts;
- Indian organizations involved in the development and design of advanced SFRs (IGCAR and BHAVINI);

- Representatives of design organizations of innovative SFRs currently under development;
- Representatives of regulators and TSO.

GIF will provide a final list of participants from their side, including the representatives of SFR designers and regulators/TSO.

The list of participants from IAEA offices may include (but is not limited to):

- Mr A. Bychkov, Mr JK. Park, Mr T. Koshy, Mr Z. Drace, Mr A. Korinny, Mr J. Lyons, Mr P. Hughes, Mr J. Yllera;
- Heads and staff of other NENP Sections/Groups.

4. LOCATION

The meeting will be held at the IAEA's Headquarters in Vienna, Austria, **Room M7** (Building M).

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5. IAEA SECRETARIAT

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