IAEA
原子用于和平与发展
الوكالة الدولية للطاقة الذرية
国 际 原 子 能 机 构
International Atomic Energy Agency
Agence internationale de l'énergie atomique
Международное агентство по атомной энергии
Organismo Internacional de Energía Atómica

地址：Vienna International Centre, PO Box 100, 1400 Vienna, Austria
电话：(+43 1) 2600 • 传真：(+43 1) 26007
电子信箱：Official.Mail@iaea.org • 因特网：https://www.iaea.org

复函请援引：EVT2401302
直接拨打分机：(+43 1) 2600-22760

奥地利
维也纳 1190
Hohe Warte 3
中国常驻国际原子能机构代表团
驻地代表
李松先生阁下

2024 年 11 月 5 日

阁下：

我荣幸地通知您，国际原子能机构（原子能机构）将于 **2024 年 12 月 16 日至 19 日**在奥地利维也纳原子能机构总部举行启动关于**“包括小型模块堆在内的先进反应堆包覆颗粒燃料的燃料建模活动”的协调研究项目的顾问会议**（以下称“活动”）。

这次活动的目的是讨论参加题为“包括小型模块堆在内的先进反应堆包覆颗粒燃料的燃料建模活动”的协调研究项目的成员的活动计划。

这次活动将使用英文。

秘书处认为：

Liu Bing 先生（中国北京市海淀区清华园 1 号；电子信箱：bingliu@tsinghua.edu.cn）

Yu Dali 先生（中国合肥市蜀山湖路 350 号中国科学院合肥物质科学研究院核能安全技术研究所；邮编：230031；电子信箱：dlyu@inest.cas.cn）

He Kai 先生（中国北京西三环北路 117 号中国核电工程有限公司；840 号信箱；邮编：100840；电子信箱：hekai@cnpe.cc）

Zhang Tian 先生（中国黑龙江省哈尔滨市南通大街 145 号哈尔滨工程大学核科学与技术学院副教授；邮编：1500001；电子信箱：tian.zhang@hrbeu.edu.cn）

Wang Longcong 先生（中国黑龙江省哈尔滨市南岗区哈尔滨工程大学核科学与技术学院；邮编：150001；电子信箱：longcongwang@hrbeu.edu.cn）

Zeng Kaiyue 女士 （中国广州越秀区梅花路 75 号广东电网电力调度控制中心核电厂功率调节实验室，邮编：510699；电子信箱：kaiyuezeng@gmail.com）

作为专家能够为这次活动做出宝贵贡献，并将因此感谢贵国政府考虑接受原子能机构对他们的指定。

我们的理解是，与这些专家提供服务有关的所有费用将由这些专家所属主管部门支付。

应注意，原子能机构对个人财产遭受的任何损坏或损失概不赔偿。原子能机构也不向原子能机构活动的参加者提供健康保险。因此，个人应做私人保险安排。但是，原子能机构将就明显因为原子能机构工作而引起的事故和疾病提供保险。

如能不迟于 2024 年 12 月 9 日收到贵国政府的回复，我将不胜感谢。

向阁下致以最崇高的敬意。

核能部
核燃料循环和废物技术司
司长

奥廖娜·米克莱丘克

附件（仅以英文印发）：资料单

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Consultancy Meeting to Launch the Coordinated Research Project on Fuel Modelling Exercises for Coated Particle Fuel for Advanced Reactors Including Small Modular Reactors

IAEA Headquarters, Vienna, Austria
and virtual participation via Cisco Webex
16 – 19 December 2024

Ref. No.: EVT2401302

Information Sheet

Introduction

For decades the IAEA has supported Member States in various aspects to improve the reliability of fuel for nuclear power reactors. The high temperature gas-cooled reactor (HTGR) concept has been considered as a potential supplement to the light water reactor (LWR) concept, taking account of its inherent safety and operational features over the LWR concept. Typically, HTGRs utilize tri-isotropic coated particle fuels (TRISO particles). These fuels exhibit enhanced safety features relative to pellet fuels, including fission product retention at high temperatures resulting from SiC and pyrolytic carbon (PyC) coating layers. Reactors using coating particle fuel have the potential to supply high temperature process heat, which may be utilized in industrial manufacturing, as district heating, or in the process of hydrogen production in addition to electricity generation. Nowadays there is an increasing international interest in developing reactors which use TRISO-coated particle fuel and many MSs are actively involved in deployment TRISO - fuelled SMRs.

The fundamental design for a gas-cooled reactor relies on the understanding of the behaviour of a coated particle fuel. Research programmes have been pursued in some Member States on fuel development focusing on TRISO-coated particle fuel design, fabrication methods, fuel characterization, irradiation performance, accident simulation testing and performance modelling to predict the behaviour of TRISO fuel under normal and off-normal operating conditions.

Several countries are developing their own TRISO fuel performance analysis codes. Modelling and simulation allow prediction of TRISO fuel behaviour when subject to neutron flux and in

high-temperature accident scenarios. The refinement of the fuel performance models and codes is performed by comparison to in-pile and out-of-pile experimental data that reproduce the expected irradiation conditions in HTGRs or similar TRISO-fuelled reactor concepts.

Historically, the IAEA developed two benchmarks dedicated to the validation of predictive methods for fuel and fission products' behaviour in the framework of the Coordinated Research Project CRP-2, the results of which were published in 1997 (see below). CRP-2 was later updated to cover fuel fabrication, quality assurance, irradiation performance, safety testing, and spent fuel. As part of the CRP-6 (2012) on HTGR reactor fuel technology, a set of benchmarking activities were developed to compare fuel performance codes under normal operation and operational transients. For the benchmark exercise on simulating real irradiation or heating experiments, a large code-to-code discrepancy in the release of fission products was recognized.

As the results of these activities, the IAEA has published:

- The IAEA-TECDOC-978 entitled "Fuel performance and Fission product Behaviour in Gas Cooled Reactors" (1997).

- The IAEA-TECDOC-1645 entitled "High Temperature Gas Cooled Reactor Fuels and Materials" (2010).

- The IAEA-TECDOC-1674 entitled "Advances in High Temperature Gas Cooled Reactor Fuel Technology" (2012).

During the Consultancy Meeting, held in June 2023, to Discuss a New Coordinated Research Project on Fuel Modelling Exercises for High Temperature Gas Cooled Reactors, Including Small and Modular Reactors, gaps in knowledge in material properties essential for fuel performance modelling, were identified. These gaps could potentially hinder the deployment of HTGR technology.

Identified gaps include:

- A lack of material properties' knowledge (e.g., buffer, uranium oxycarbide (UCO) kernel) for proper modelling of relevant failure mechanisms.

- Missing experimental data for reactivity-initiated accidents (RIA) on irradiated fuel.

- An accurate list of dominant Fission Products (FPs) for Source Term (current list for modelling: Ag, Cs, Sr, I/Kr/Xe, incomplete modelling parameters: Ba, Ce, Eu, Ru).

To increase the confidence in the use of fuel performance codes that support coated particle fuelled reactors' deployment, the IAEA initiated a new Coordinated Research Project on "Fuel Modelling Exercises for Coated Particle Fuel for Advanced Reactors Including Small Modular Reactors" (CRP T12034), which will be focused on:

1. Improving the knowledge and filling the gaps of key TRISO fuel properties for codes' development (e.g., diffusivity, creep, thermal conductivity, mechanical properties, SiC strength) with new data (e.g., obtained from new experiments and/or generated by multiscale modelling) to provide input to these codes,
2. The implementation of all the important TRISO particle failure modes into fuel performance codes that will be used for the validation against TRISO fuel experiments,

3. Gathering the operating and transient envelopes for TRISO-fuelled reactors relevant to participating Member States (MSs) for potential new measurements of fuel properties and new calculations,
4. Evaluating existing RIA tests and evaluating gaps with accident conditions in TRISO-fuelled reactors relevant to participating MSs for potential new measurements of fuel properties and new calculations,
5. The development of the list of the FPs that are of importance to the selective criteria (e.g., highest yield, toxicity) to model their transport and release for licensing purposes, and to develop the methodology used to define the importance of each FP,
6. The development of a database based on existing experimental data and new dataset collection to validate the codes,
7. Performing code benchmark exercises, including uncertainty propagation.

Objectives

The purpose of the event is to discuss the activity plans of members participating in the coordinated research project entitled “Fuel Modelling Exercises for Coated Particle Fuel for Advanced Reactors Including Small Modular Reactors”.

Target Audience

Participants should be current or potential members participating in the coordinated research project entitled “Fuel Modelling Exercises for Coated Particle Fuel for Advanced Reactors Including Small Modular Reactors”.

Working Language

English.

Expected Outputs

The scope of the research proposals from each interested organization will be clarified to align with the objectives of the CRP T12034 and to develop the work plan for the CRP.

Venue

The event will be held at the Vienna International Centre (VIC), where the IAEA's Headquarters are located. Participants must make their own travel and accommodation arrangements.

General information on the VIC and other practical details, such as a list of hotels offering a reduced rate for IAEA participants, are listed on the following IAEA web page:

www.iaea.org/events.

Participants are advised to arrive at Checkpoint 1/Gate 1 of the VIC one hour before the start of the event on the first day in order to allow for timely registration. Participants will need to present an official photo identification document in order to be admitted to the VIC premises.

Additional Information

The Consultancy Meeting will be held in Hybrid mode (using WebEx and face to face) and will start at 13-00 (Vienna time) 16 December 2024 in Meeting room M0E12. We will provide a link to access the WebEx meeting a week before the event.

IAEA Contacts

Scientific Secretary:

Ms Anzhelika KHAPERSKAIA
Division of Nuclear Fuel Cycle and Waste Technology
Department of Nuclear Energy
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 VIENNA
AUSTRIA

Tel.: +43 1 2600 22760
Fax: +43 1 26001
Email: A.Khaperskaia@iaea.org

Administrative Secretary:

Ms Sonya BENITEZ-NAVARRO
Division of Nuclear Fuel Cycle and Waste Technology
Department of Nuclear Energy

International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 VIENNA
AUSTRIA
Tel.: +43 1 2600 22 470
Email: s.benitez-navarro@iaea.org

Subsequent correspondence on scientific matters should be sent to the Scientific Secretary and correspondence on other matters related to the event to the Administrative Secretary.