IAEA
International Atomic Energy Agency

Technical Meeting on Progress in Performance Assessment and Regulation of Passive Safety Systems in Advanced Nuclear Power Plant Designs

IAEA Headquarters, Vienna, Austria

and virtual participation via Microsoft Teams

10-14 March 2025

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Information Sheet

Introduction

Since the beginning of nuclear power development, the use of passive systems for accomplishing safety functions, i.e., those that take advantage of natural forces such as gravity, natural convection, or accumulated internal energy, has been considered as a promising safety approach. A variety of passive systems, such as reactor shutdown systems, pressurized hydro-accumulators, and containment pressure suppression systems, have therefore been in use for many years. Advanced nuclear power plant designs and specifically small modular reactor (SMR) designs rely more heavily on passive systems to fulfil various safety functions. Passive systems are valued for not requiring human intervention and for being able to operate without external support systems such as power supply systems. Advances in safety analysis methods and testing facilities for passive phenomena, a strong reliance on inherent and passive design features has become a hallmark of many nuclear power plant (NPP) designs, including several evolutionary designs and nearly all innovative NPP designs. However, the effectiveness of these features needs to be adequately demonstrated.

The widely accepted classification outlined in the 1991 IAEA-TECDOC-626 "Safety related terms for advanced nuclear plants" identifies four categories of passive systems:

Category A. This category is characterized by the following: no signal inputs, no external power sources, nor forces; no moving mechanical parts, no moving working fluid.

Category B. This category is characterized by the following: no signal inputs, no external power sources, nor forces, no moving mechanical parts, but moving working fluids.

Category C. This category is characterized by the following: no signal inputs, no external power sources, nor forces; but moving mechanical parts, whether or not moving working fluids are also present.

Category D. This category addresses the intermediary zone between active and passive where the execution of the safety function is made through passive methods as described in the previous categories except that an external signal is required to trigger the passive process. To recognize this departure, this category is referred to as "passive execution/active initiation".

Category A passive safety systems design principles are generally well studied and designed in accordance with internationally recognized codes. This category of passive systems (such as barriers) is out of scope of the event.

For categories B to D passive systems relying on low driving forces, the range of conditions necessary to perform the safety function could be narrow. Thus, demonstration that a passive system using low driving forces can ensure a safety function with a necessary level of reliability should recognize, and when relevant address, the following that could be different compared to active systems:

- Failure modes (comprehensive knowledge and understanding of phenomena that could influence the performance of a passive system should be established). Methods for passive system reliability analyses;
- Impact of environmental conditions, internal and external hazards on passive system performance;
- Application of safety margins, to ensure distance to cliff-edge effects;
- The dynamic behavior of passive systems performance. Instabilities in passive systems;
- Other factors.

Also, designs with passive systems may require special consideration of aspects such as defence in depth implementation, protection against common cause failures, redundancy, and diversity principles implementation.

Objectives

The primary objective of the event is to create a platform for discussion, experience sharing, and knowledge dissemination regarding the performance assessment and regulation of advanced nuclear power plant designs (including SMRs) that use passive safety systems.

The focus will be on categories B-D passive safety systems, as described above, that utilize moving fluids (liquid or gas) for heat removal from the reactor, fuel storage, or containment, as well as those that use moving fluids for reactivity control. Additionally, the event will feature presentations on ongoing IAEA activities related to passive systems in nuclear power plants.

Target Audience

The event is aimed at professionals from organizations involved in the design of nuclear power plants (NPPs), operating organizations, universities, nuclear regulatory authorities, technical support organizations, and research institutions engaged in activities related to or supporting the development or regulation of advanced NPPs.

It is open to representatives from all Member States with an active nuclear power programme, including those from countries in the advanced stages of their nuclear programme.

Working Language(s)

English

Expected Outputs

The expected output of the event includes dissemination of knowledge related to the consideration of requirements and recommendations in the design of current and advanced NPPs (including SMRs), including lessons learned from the exchange of experience on the current Member States' practice related to this topic.

The insights gained from the event will be considered for future technical review services offered by the IAEA.

Topics

The following topics (tracks) are proposed for discussion during the event:

- Failure modes of passive systems. Identification and modelling of phenomenological (functional) failures.
- Methods for reliability analyses for passive systems.

- Safety margins and cliff-edge effect considerations in designing passive systems.
- Development and validation of passive system models. Experimental and calculational tools and studies to support passive system performance demonstration. Qualification programmes.
- Dynamic behavior of passive systems. Instabilities in passive systems.
- Defence in depth in plant designs with passive systems (Independence of defence in depth levels. Protection against common cause failures. Redundancy and diversity. Application of single failure criterion).
- Impact of environmental conditions, as well as internal and external hazards, on the performance of passive systems.
- Deterministic and probabilistic considerations in designing NPPs with passive systems.
- Commissioning programmes for NPP designs with passive systems. Operating limits and conditions. Maintenance, calibration, testing and inspections. Ageing management aspects. Considerations optimal operator performance and monitoring of passive systems during operation.
- Regulatory perspectives: requirements, guidance, and expectations for the safety demonstration of passive systems.
- Lessons learned in designing and regulating NPPs with passive systems.

Participation and Registration

All persons wishing to participate in the event have to be designated by an IAEA Member State or should be members of organizations that have been invited to attend.

In order to be designated by an IAEA Member State or invited organization, participants are requested to submit their application via the InTouch+ platform (https://intouchplus.iaea.org) to the competent national authority (Ministry of Foreign Affairs, Permanent Mission to the IAEA or National Atomic Energy Authority) or organization for onward transmission to the IAEA by **12 December 2024**, following the registration procedure in InTouch+:

1. Access the InTouch+ platform (https://intouchplus.iaea.org):
   - Persons with an existing NUCLEUS account can sign in to the platform with their username and password;
   - Persons without an existing NUCLEUS account can register here.

2. Once signed in, prospective participants can use the InTouch+ platform to:
   - Complete or update their personal details under 'Complete Profile' and upload the relevant supporting documents;
   - Search for the relevant event under the 'My Eligible Events' tab;
   - Select the Member State or invited organization they want to represent from the drop-down menu entitled 'Designating Authority' (if an invited organization is not listed, please contact InTouchPlus.Contact-Point@iaea.org);
   - If applicable, indicate whether financial support is requested and complete the relevant information (this is not applicable to participants from invited organizations);
   - Based on the data input, the InTouch+ platform will automatically generate the Participation Form (Form A) and/or the Grant Application Form (Form C);
   - Submit their application.

Once submitted through the InTouch+ platform, the application, together with the auto-generated form(s), will be transmitted automatically to the required authority for approval. If approved, the

application, together with the applicable form(s), will automatically be sent to the IAEA through the online platform.

NOTE: The application for financial support should be made, together with the submission of the application, by **12 December 2024**.

For additional information on how to apply for an event, please refer to the InTouch+ Help page. Any other issues or queries related to InTouch+ can be sent to InTouchPlus.Contact-Point@iaea.org.

Selected participants will be informed in due course on the procedures to be followed with regard to administrative and financial matters.

Participants are hereby informed that the personal data they submit will be processed in line with the Agency's Personal Data and Privacy Policy and is collected solely for the purpose(s) of reviewing and assessing the application and to complete logistical arrangements where required. The IAEA may also use the contact details of Applicants to inform them of the IAEA's scientific and technical publications, or the latest employment opportunities and current open vacancies at the IAEA. These secondary purposes are consistent with the IAEA's mandate. Further information can be found in the Data Processing Notice concerning IAEA InTouch+ platform.

Papers and Presentations

The IAEA encourages participants to submit papers and provide presentations on the work of their respective institutions that falls under the topics listed above.

Participants who wish to submit a paper and provide presentations are requested to submit an abstract of their work. The abstract will be reviewed as part of the selection process for presentations. The abstract should be in A4 page format, should extend to no more than two pages (including figures and tables), and should not exceed 1500 words. It should be sent electronically to Mr. Mikhail Lankin and Mr. Alexei Miassoedov, the Scientific Secretaries of the event (see contact details below), not later than **12 December 2024**. Authors will be notified of the acceptance of their proposed presentations by **25 January 2025**.

In addition to the registration already submitted through the InTouch+ platform, participants have to submit the abstract to their competent national authority (e.g., Ministry of Foreign Affairs, Permanent Mission to the IAEA or National Atomic Energy Authority) or organization for onward transmission to the IAEA not later than **12 December 2024**.

Expenditures and Grants

No registration fee is charged to participants.

The IAEA is generally not in a position to bear the travel and other costs of participants in the event. The IAEA has, however, limited funds at its disposal to help meet the cost of attendance of certain participants. Upon specific request, such assistance may be offered to normally one participant per

country, provided that, in the IAEA's view, the participant will make an important contribution to the event.

The application for financial support should be made, together with the submission of the application, by **12 December 2024**.

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.

Visas

Participants who require a visa to enter Austria should submit the necessary application to the nearest diplomatic or consular representative of Austria at least four weeks before they travel to Austria. Since Austria is a Schengen State, persons requiring a visa will have to apply for a Schengen visa. In States where Austria has no diplomatic mission, visas can be obtained from the consular authority of a Schengen Partner State representing Austria in the country in question.

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Subsequent correspondence on scientific matters should be sent to the Scientific Secretaries.

Event Web Page

Please visit the following IAEA web page regularly for new information regarding this event:

www.iaea.org/events/EVT2403660