## Technical Meeting on the Safety Approach for Liquid Metal Cooled Fast Reactors and the Analysis and Modelling of Severe Accidents

Monday, 13 March 2023 - Friday, 17 March 2023

IAEA

## **Book of Abstracts**

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Technical Session 2.4: Accident Expansion Phase and Long Term Behavior in SFR / 4

## Analysis of the remaining core material coolability in a SFR core

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Confirmation that the work is original and has not been published anywhere else.:
Yes
Topic of the Abstract:
Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.4: Accident Expansion Phase and Long Term Behavior in SFR / 6

## Development of an evaluation method for in-place cooling of a degraded core in severe accidents of sodium-cooled fast reactors

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 7

## Status of numerical tool development for initiating phase in severe accidents of SFRs in Japan

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Technical Session 1.2: Safety Approach for SFR / 8

## Consideration on safety design approach for future SFRs in Japan, featuring prevention and mitigation of a severe accident

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 1 Safety approach for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 10

## Development of analysis methods for SFR severe accidents in JAEA and assessment of applicability to safety analysis

**Co-authors:** Hirotaka TAGAMI<sup>1</sup>; Shinya ISHIDA<sup>1</sup>; Yu-ichi ONODA<sup>1</sup>; Jouji SOGABE<sup>1</sup>; Yasushi OKANO<sup>1</sup>

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Confirmation that the work is original and has not been published anywhere else.:

No

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 11

### Design features and safety assessment of a sodium-cooled fast reactor in Japan for mitigation of severe accidents

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Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 12

## Heat Transfer Characteristics of liquid metal Fast reactors

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#### Confirmation that the work is original and has not been published anywhere else.:

#### Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part II  $\prime$  22

## Modern approaches to deterministic safety analysis for sodium fast reactors

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 1.2: Safety Approach for SFR / 23

## Sodium Fast Reactor Severe Accident Prevention and Mitigation Strategy: U.S. Perspective

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Yes

**Topic of the Abstract**: Subtrack 1 Safety approach for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 24

## The Simplified Radionuclide Transport (SRT) Code for the Source Term Assessment of Pool-Type Metal Fuel Sodium Fast Reactor Severe Accidents

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Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 25

## Recent developments in modeling of severe accident analysis code PREDIS

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Yes

#### Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 26

## SFRs severe accident transient study with new particle flow model in SIMMER-V

Authors: Laurent Trotignon<sup>1</sup>; Eszter Csengeri<sup>2</sup>

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 1.3: Safety Approach for LFR / 27

### **MYRRHA Pre-licensing Nuclear Safety Approach**

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Confirmation that the work is original and has not been published anywhere else.:

Yes

**Topic of the Abstract**: Subtrack 1 Safety approach for LMFR Technical Session 1.2: Safety Approach for SFR / 28

## Mitigation of severe accident by design: strategy and study approach

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CEA

Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 1 Safety approach for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 29

## 3D Thermalhydraulics-neutronics simulation of SFR core degradation with the SEASON French Platform

Authors: Pierre GUBERNATIS<sup>1</sup>; Laurent TROTIGNON<sup>1</sup>

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part II / 30

## Design-oriented simulation tools in French SFR projects

Authors: Jean-Baptiste Droin<sup>1</sup>; Frédéric BERTRAND<sup>2</sup>; Remi Clavier<sup>None</sup>

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 31

### CEA Experimental Roadmap for Sodium Fast Reactor Severe Accident R&D

**Co-authors:** Eric Pluyette <sup>1</sup>; François Charollais <sup>1</sup>; Rémi Clavier <sup>1</sup>; Alexandre Lecoanet <sup>1</sup>; Nathalie Seiler <sup>1</sup>; Jules Delacroix <sup>1</sup>; Andrea Quaini <sup>2</sup>; Andrea Bachrata <sup>1</sup>; Frany Derasse <sup>1</sup>; Fréderic Payot <sup>1</sup>

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Confirmation that the work is original and has not been published anywhere else.:

Yes

**Topic of the Abstract**:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.4: Accident Expansion Phase and Long Term Behavior in SFR / 32

## French research programs related to the severe accident phenomenology in the lower plenum of a SFR

**Authors:** Nathalie Seiler<sup>1</sup>; Alexandre Lecoanet<sup>1</sup>; Barbara Bigot<sup>None</sup>; Claude Brayer<sup>1</sup>; Jérôme Francescato<sup>1</sup>; Cyriaque Treol<sup>1</sup>; Antoine Avrit<sup>1</sup>

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Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part I / 33

## Towards an integrated French software platform for severe accident simulation in SFR

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Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.1: Severe Accident Analysis and Experimental Validation of SFR - Part II / 34

## ARDECO CEA-KIT cooperation on ASTRID safety studies and related code developments

**Authors:** Lena Andriolo<sup>1</sup>; Xue-Nong Chen<sup>2</sup>; Michael Flad<sup>3</sup>; Simone Gianfelici<sup>4</sup>; Liancheng Guo<sup>5</sup>; Marco Marchetti<sup>6</sup>; Mattia Massone<sup>4</sup>; Barbara Vezzoni<sup>6</sup>

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 35

## Development of fuel deformation module during Power and Flow Transient in Sodium Cooled Fast Reactor Core

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Atomic Energy Regulatory Board

Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

36

## The Modern Combined License Application for the Commercialization of Advanced Fission Technologies

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Organization:

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Confirmation that the work is original and has not been published anywhere else.:

Yes

**Topic of the Abstract**: Subtrack 1 Safety approach for LMFR

Technical Session 2.4: Accident Expansion Phase and Long Term Behavior in SFR / 39

# Analysis methodologies for the evaluation of ATWS accident on SFR in JAEA - Mechanical consequences during expansion phase of the accident -

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<sup>1</sup> Japan Atomic Energy Agency

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 40  $\,$ 

## Safety analysis of the BREST-OD-300 reactor

**Authors:** V.V. Lemekhov<sup>1</sup>; A.V. Moiseev<sup>1</sup>; V.S. Smirnov<sup>1</sup>; A.A. Bazhanov<sup>1</sup>; A.V. Proukhin<sup>1</sup>; A.G. Muratov<sup>1</sup>; A.V. Stremin<sup>1</sup>; V.P. Vasyukhno<sup>1</sup>; N.Ye. Dubenkov<sup>1</sup>

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Yes

#### Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

#### Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 41

### Development of drift-flux correlations for vertical forward bubble column-type gas-liquid lead-bismuth two-phase flow

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Confirmation that the work is original and has not been published anywhere else.:

#### Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 42

### Severe accidents investigations for lead fast reactors in Romania

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#### Organization:

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#### Confirmation that the work is original and has not been published anywhere else.:

Yes

#### Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 1.3: Safety Approach for LFR / 43

## Safety approach of the Westinghouse lead fast reactor

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 1 Safety approach for LMFR

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 46

## Status of the SAS4A code metallic fuel models for the simulation of severe accidents in liquid metal cooled fast reactors

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<sup>1</sup> ANL, USA

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Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 47

## Modelling of the lead-cooled fast reactor accidents with the EU-CLID/V2 multiphysics code

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Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

**Opening Session / 49** 

### **IAEA Welcome Remarks**

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Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

**Opening Session / 50** 

## **Objective of the Meeting**

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**Country of origin**:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

**Opening Session / 51** 

## **Administrative Remarks**

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Introduction of the participants Approval of the agenda Appointment of the chairs

**Country of origin**:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Closing Session / 52

## **Technical Meeting Wrap-Up Facilitated by Session Chairs**

**Country of origin**:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

**Closing Session / 54** 

## **Closing Remarks by the IAEA**

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Country of origin:

#### Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

56

## Social Event - Reception hosted by the IAEA

**Country of origin**:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 58

## Modeling of severe accidents for sodium and lead cooled reactors

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Organization:

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Confirmation that the work is original and has not been published anywhere else.:

Yes

Topic of the Abstract:

Subtrack 2 Analysis and Modelling of Severe Accidents for LMFR

Closing Session / 60

## **Outputs from the Technical Meeting and General Discussion**

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Plans for the development of the two TECDOCs and advice for possible future IAEA activities.

Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.1: Related IAEA and International Activites / 61

## Consideration of Non-Water Cooled Reactors and SMR Safety in the IAEA Safety Standards

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Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.1: Related IAEA and International Activites / 62

## IAEA activities in the field of fast reactor technology

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Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.3: Safety Approach for LFR / 63

## ENEA contribution to the development of GIF Safety Design Criteria for LFR

Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 2.3: Accident Analysis and Experimental Programs for LFR / 64

## Experimental and Modelling and simulation activities supporting the development of LFR technology

Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 3: Regulatory Experience and Activities / 65

## Safety review experience of PFBR and development of Safety Code on Design of FBRs

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**Country of origin**:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.2: Safety Approach for SFR / 66

### Prevention and Mitigation Measures for Severe Accidents of China Fast Reactor

Country of origin:

Organization:

#### Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.2: Safety Approach for SFR / 67

## Consideration of severe accidents in the past French SFR program

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Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.2: Safety Approach for SFR / 68

### ARC-100 Commercial Demonstration Unit Optimizations for Decay Heat Removal Systems to Accommodate Accident Scenarios

Country of origin:

Organization:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 1.3: Safety Approach for LFR / 69

## An introduction to NewCleo LFR design and initial safety considerations

Country of origin:

**Organization**:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

#### Technical Session 1.1: Related IAEA and International Activites / 70

### Development of Safety Design Criteria and Safety Design Guidelines for the Sodium cooled Fast Reactor within the Generation IV International Forum

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Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 3: Regulatory Experience and Activities / 71

## Assessment of severe accident for SFR projects developed in France

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**Organization**:

Confirmation that the work is original and has not been published anywhere else.:

Topic of the Abstract:

Technical Session 2.2: Initiation and Transition Phases of Severe Accidents of SFR / 72

## **Discussion & Session Wrap Up**