

**Lawrence Livermore National Laboratory**  
7000 East Avenue, L-198, Livermore, California, 94550

**SUBJECT:** Report on the Second 2021 ICSBEP/IRPhE Technical Review Group (ZOOM) Meeting

**DATE:** December 31, 2021

**TO:** Dr. Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511

**FROM:** Dave Heinrichs<sup>5</sup>, Cihangir Celik<sup>2</sup>, Jeff Favorite<sup>1</sup>, Gary Harms<sup>4</sup>, Mike Zerkle<sup>6</sup>

**MEETING TITLE:** ICSBEP/IRPhE Technical Review Group and Candidate SINBAD Experiments, OECD NEA: 13-16 December 2021

**MEETING LOCATION:** On-line, hosted by OECD Nuclear Energy Agency (NEA)

**MEETING DATES:** December 13-16, 2021

**ATTENDEES ON BEHALF OF NCSP:** Kelsey Amundson<sup>1</sup>, Doug Bowen<sup>2</sup>, Cihangir Celik<sup>2</sup>, Jeff Favorite<sup>1</sup>, Nina Fleming<sup>3</sup>, Joetta Goda<sup>1</sup>, Gary Harms<sup>4</sup>, Ayman Hawari<sup>3</sup>, Dave Heinrichs<sup>5</sup>, Soon Kim<sup>5</sup>, Alex Lang<sup>2</sup>, B. J. Marshall<sup>2</sup>, Geordie McKenzie<sup>1</sup>, Alex McSpaden<sup>1</sup>, Jesse Norris<sup>5</sup>, Catherine Percher<sup>5</sup>, Alex Shaw<sup>2</sup>, Nick Thompson<sup>1</sup>, Morgan White<sup>1</sup>, Mike Zerkle<sup>6</sup>

<sup>1</sup>LANL (7), <sup>2</sup>ORNL (5), <sup>3</sup>NCSU (1), <sup>4</sup>SNL (2), <sup>5</sup>LLNL (4), <sup>6</sup>NNL (1)

**MEETING PURPOSE:**

Due to the large number of benchmark submissions in 2021, this (second) meeting is a continuation of the (first) ICSBEP/IRPhE/SINBAD meeting previously convened on October 11-14, 2021<sup>1</sup>.

The meeting began with an announcement from Ian Hill (NEA) that Dr. John Bess is stepping down as Chair of ICSBEP and IRPhE and that nominations for chair and deputy chair of these two projects are solicited until March 31, 2022. Nominations for the ICSBEP chair and deputy chair should be submitted to Julie-Fiona Martin at [Julie-Fiona.MARTIN@oecd-nea.org](mailto:Julie-Fiona.MARTIN@oecd-nea.org), and nominations for the IRPhE chair and deputy chair should be submitted to Ian Hill at [Ian.Hill@oecd-nea.org](mailto:Ian.Hill@oecd-nea.org).

Two new NCSP evaluations were reviewed by members of the ICSBEP Technical Review Group (TRG) constituted from the meeting attendees:

- HEU-MET-INTER-011: CURIE: 235U Unresolved Resonance Region Experiment, Jeff Favorite (LANL)

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<sup>1</sup> LLNL-MI-829200, "Report on the 2021 ICSBEP and SINBAD Technical Review Group (ZOOM) Meeting," October 31, 2021.

- HEU-MET-MIXED-021: TEX-HEU Baseline Assemblies: Highly Enriched Uranium Plates with Polyethylene Moderator and Polyethylene Reflector, Jesse Norris (LLNL)

Both evaluations were accepted pending resolution of the TRG review comments completing CED-4a. One additional new joint NE-NCSP evaluation was also reviewed by the TRG:

- SUB-SPEC-MISC-THERM-000: Benchmark of Neutron Thermalization in Graphite Using the Slowing-Down-Time ORELA Experiment, Ayman Hawari (NCSU)

This evaluation was accepted as a fundamental physics benchmark (FUND-ORELA-ACC-GRAPH-PNSDT-001) pending resolution of the TRG and Subgroup comments. Note that there was considerable interest in this unique slowing down benchmark as it demonstrates the need for, as well as the outstanding performance of, the new thermal scattering laws available in ENDF/B-VIII.0 and ENDF/B-VIII.1 for nuclear reactor graphite with 10%, 20%, and 30% porosity developed at NCSU under joint NR-NCSP auspices.

As members of the Technical Review Group, the NCSP and other attendees participated in review of non-NCSP evaluations including two new JAEA/LANL ICSBEP and one new IPEN IRPhE evaluation:

- IEU-MET-FAST-025: ZEUS: Fast Spectrum Critical Assembly with a Mixed Core of Highly Enriched and Natural Uranium Containing Lead Surrounded by a Copper Reflector, Akito Oizumi (JAEA)
- PU-MET-FAST-047: Plutonium Metal Plates Moderated by Lead and Reflected by Copper, Alex McSpaden (LANL)
- IPEN(MB01)-LWR-RESR-021: Benchmark of Reactivity Determination to Support Validation of Evaluated Delayed Neutron Data, Adimir dos Santos (IPEN)

All three evaluations were approved for publication in ICSBEP and IRPhE pending adequate resolution of TRG review comments. Note that the IPEN/MB-01 reactor configuration in the IPEN evaluation is identical to that previously published as IPEN(MB01)-LWR-RESR-001. The new evaluation is focused on determining reactivity ( $\rho$ ) from other kinetics parameters<sup>2</sup> derived from classic reactor noise analysis techniques.

Additionally, the meeting included a discussion of proposed minor revisions to one previously approved NCSP ICSBEP evaluation and four previously approved non-NCSP IRPhE evaluations:

- PU-MET-MIXED-002: TEX Plutonium Baseline Assemblies: Plutonium/Aluminum Metal Alloy Plates with Varying Thicknesses of Polyethylene Moderator and a Thin Polyethylene Reflector, Catherine Percher (LLNL)
- ZPPR-LMFR-EXP-001, -002, 005, & -006: ZPPR-10A, -9, -10B & -10C Experiments, K. Yokoyama (JAEA)

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<sup>2</sup>  $\beta_{\text{eff}}$  and  $\Lambda$  from IPEN(MB01)-LWR-RESR-001,  $\lambda_1$  from Annals of Nuclear Energy **33**, 917-923 (2006) and  $\beta_i$  and  $\lambda_{i>1}$  from NSE **152**, 125-141 (2006).

The revisions to the TEX evaluation includes minor corrections to the benchmark model, benchmark k-eff values, and C/E results. The revision will also include sample MC21 and SCALE results from NNL and ORNL, respectively.

The revisions in the ZPPR evaluations provide new appendices containing additional details correcting the as-built configurations but, due to the difficulty of this task, the benchmark model has not been changed (at this time). The chair will attempt to confirm the correctness of the proposed changes with Argonne National Laboratory personnel (e.g., Richard Lell and Roger Blomquist (retired)).

The meeting also included the following presentations:

- Update on DICE and IDAT tools, Ian Hill (NEA)
- TVA WB1 Benchmark Specifications Updates and Preliminary Results for Exercises 1 and 2, Thamer Albagami et al. (NCSU)
- OECD/NEA MPCMIV Benchmark Year 1 Update, Quentin Faure et al. (NCSU)
- Completion of current (2020 edition) of the ICSBEP and IRPhE Handbooks
- Date and place for future meetings

The 2020 editions of the ICSBEP and IRPhE Handbooks will likely be published by February and April 2022, respectively. The next ICSBEP/IRPhE meetings will be hosted by NEA and are tentatively scheduled in-person either the week of October 3-7 or October 10-14, 2022.

In separate correspondence, Dr. Tatiana Ivanova clarified that there is no mandated technical review group for SINBAD. The Expert Group on Physics of Reactor Systems (EGPRS), under the auspices of the Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS), agreed to form a task force aimed at incrementally improving and collecting proposed updates to SINBAD data. Thomas Miller (ORNL) is leading the Task Force and currently polling the community for members.

#### **MEETING BENEFITS TO THE NCSP:**

##### ICSBEP

The USDOE Office of Defense Programs founded the Criticality Safety Evaluation Project (CSBEP) in 1992 to document and preserve criticality safety benchmark experiments. In 1994, the CSBEP welcomed international participants from France, Hungary, Japan, Russia, and the United Kingdom; and in 1995, the DOE allowed the CSBEP to become an official activity of the OECD NEA to further enhance international participation and changed the name to the ICSBEP. As described in the USDOE NCSP Mission and Vision, Five-Year Execution Plan, and CEEdT Manual, the ICSBEP remains an important element of information preservation and dissemination.

##### IRPhE

The International Reactor Physics Experiment Evaluation (IRPhE) Project is a follow-on to the ICSBEP focused on the totality of experimental reactor physics data including, but not limited to, critical data. A

subset of the critical data benefits NCSP. However, due to the physical complexity of real reactor systems, uncertainties in this critical data is often much too large (e.g., > 1%  $\Delta k$ ) to benefit NCSP users or inform nuclear data evaluation.

**PURPOSE OF TRAVEL:** Not applicable. NEA decided upon an on-line ZOOM meeting due to continuing COVID-19 concerns and restrictions.

**AUSPICES:** This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

**ATTACHMENT:** Agenda, ICSBEP/IRPhE Technical Review Group and Candidate SINBAD Experiments, Online Hosted by OECD NEA, 13-16 December 2021.

**DISTRIBUTION:**

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**PARTICIPANTS:**

<u>Attendee</u>	<u>Affiliation</u>	<u>Country</u>
Thamer Albagami	NCSU	USA
Kelsey Amundson	LANL, NCSP	USA
John Bess	NEA	USA
Doug Bowen	ORNL	USA
Mariya Brovchenko	IRSN	France
Oliver Buss	NEA	France
Cihangir Celik	ORNL	USA
Shin Chang-Ho	Hanyang Univ.	Korea
Jean-Baptiste Clavel	IRSN	France
Rowdy Davis	UNM	USA
Gregory Delipei	NCSU	France
Adimir dos Santos	IPEN	Brazil
Quentin Faure	Univ. of Utah	USA
Jeff Favorite	LANL, NCSP	USA
Nina Fleming	NCSU	USA
Joetta Goda	LANL	USA
Satoshi Gunji	JAEA	Japan
Gary Harms	SNL, NCSP	USA
Jason Haverkamp	NNL	USA
Ayman Hawari	NCSU	USA
Dave Heinrichs	LLNL, NCSP	USA
Ian Hill	NEA	Canada
Makoto Ishikawa	JAEA	Japan
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Dennis Mennerdahl	EMS	Sweden
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Akito Oizumi	JAEA	Japan
Catherine Percher	LLNL, NCSP	USA
Bojan Petrovic	Georgia Tech.	USA
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Tim Watson	NNL	USA
Morgan White	LANL	USA
Zeyun Wu	VCU	USA
Kenji Yokoyama	JAEA	Japan
Mike Zerkle	NNL, NCSP	USA

## Attachment

### ICSBEP/IRPhE Technical Review Group and Candidate SINBAD Experiments OECD NEA: 13 – 16 December 2021

#### IRPhE/ICSBEP Technical Review Group

#### **AGENDA**

13 – 16 DECEMBER 2021

Online Hosted by OECD NEA

Meeting Registration: <http://www.oecd-nea.org/confdb/confdb/conf?id=490>

The meeting material is available on [mynea.oecd-nea.org](http://mynea.oecd-nea.org)

#### Contacts

**John.Bess@inl.gov** (chair)

**Julie-Fiona.Martin@oecd-nea.org** (technical secretariat for ICSBEP)

**Ian.Hill@oecd-nea.org** (technical secretariat for IRPhE)

**ClaudeAnnie.MangaCollard@oecd-nea.org** (assistant)

*Welcome to our virtual Technical Review Group (TRG) meeting!*

*Times below were selected to try and best support participants worldwide and are reported in Central European Summer Time (CEST) in the agenda below. Daily TRG meetings will run from 14h00 to 18h00 CEST each day. While the initial start time each day is definite, start times for individual evaluations later within that same day are approximate and might be slightly adjusted as the meeting proceeds. A chart providing quick time zone comparisons is included for your convenience:*

<b><i>PST</i></b>	<b><i>MST</i></b>	<b><i>EST</i></b>	<b><i>BRT</i></b>	<b><i>GMT</i></b>	<b><i>CET</i></b>	<b><i>MSK</i></b>	<b><i>JST</i></b>
05h00	06h00	08h00	10h00	13h00	14h00	17h00	22h00
06h00	07h00	09h00	11h00	14h00	15h00	17h00	23h00
07h00	08h00	10h00	12h00	15h00	16h00	18h00	00h00
08h00	09h00	11h00	13h00	16h00	17h00	19h00	01h00
09h00	10h00	12h00	14h00	17h00	18h00	20h00	02h00
10h00	11h00	13h00	15h00	18h00	19h00	21h00	03h00

*Please note that the OECD/NEA will record the conference and store it on NEA IT systems, in order to support secretariat work. Access will be limited to NEA staff. If you do not wish to be recorded, please leave your microphone muted and camera off.*

# ICSBEP/IRPhe Technical Review Group and Candidate SINBAD Experiments OECD NEA: 13 – 16 December 2021

Monday, 13 December 2021, IRPhe TRG			
13h50– 14h00	Join in, test your audio and video, and enjoy a brief chat with colleagues		
14h00-14h15	<b>SESSION 1:</b>	<b>WELCOME AND INTRODUCTION</b>	
		Welcome and Introduction	J. Bess
14h15-14h45	<b>SESSION 2:</b> ZPPR-LMFR-EXP-001, -002, -005, & -006	<b>REVIEW OF REVISED IRPhe EVALUATIONS</b> ZPPR-10A, -9, -10B, & -10C EXPERIMENTS	K. Yokoyama M. Ishikawa
14h45-16h45	<b>SESSION 3:</b> IPEN(MB01)-LWR-RESR-021	<b>APPROVAL OF NEW IRPhe EVALUATION</b> BENCHMARK OF REACTIVITY DETERMINATION TO SUPPORT VALIDATION OF EVALUATED DELAYED NEUTRON DATA	A. dos Santos
16h45-17h00	BREAK		
17h00 – 18h00	<b>SESSION 4:</b>	<b>IRPhe RELATED PRESENTATIONS</b>	
		Update on IDAT	I. Hill
		Status of DOE-NE NEAMS NEUP-Supported Benchmark Evaluations at NCSU	Q. Faure T. Albagami
18h	ADJOURN		

Tuesday, 14 December 2021, ICSBEP TRG			
13h50– 14h00	Join in, test your audio and video, and enjoy a brief chat with colleagues		
14h00 – 15h45	<b>SESSION 5:</b> IEU-MET-FAST-025	<b>APPROVAL OF NEW ICSBEP ICSBEP EVALUATIONS</b> ZEUS: FAST-SPECTRUM CRITICAL ASSEMBLY WITH A MIXED CORE OF HIGHLY ENRICHED AND NATURAL URANIUM CONTAINING LEAD SURROUNDED BY A COPPER REFLECTOR	A. Oizumi
15h45 – 16h00	BREAK		
16h00 – 17h45	<b>SESSION 6:</b> HEU-MET-INTER-011	<b>APPROVAL OF NEW ICSBEP EVALUATIONS (Continued)</b> CURIE: <sup>235</sup> U UNRESOLVED RESONANCE REGION EXPERIMENT	J. Favorite T. Cutler T. Grove
18h	ADJOURN		

## ICSBEP/IRPhE Technical Review Group and Candidate SINBAD Experiments OECD NEA: 13 – 16 December 2021

### Wednesday, 15 December 2021, ICSBEP TRG (Continued)

13h50– 14h00	Join in, test your audio and video, and enjoy a brief chat with colleagues		
14h00 – 15h45	<b>SESSION 7:</b>	<b>APPROVAL OF NEW ICSBEP EVALUATIONS (Continued)</b>	
	PU-MET-FAST-047	PLUTONIUM METAL PLATES MODERATED BY LEAD AND REFLECTED BY COPPER	A. McSpaden
15h45 – 16h00	BREAK		
16h00 – 17h45	<b>SESSION 8:</b>	<b>APPROVAL OF NEW ICSBEP EVALUATIONS (Continued)</b>	
	HEU-MET-MIXED-021	TEX-HEU BASELINE ASSEMBLIES: HIGHLY ENRICHED URANIUM PLATES WITH POLYETHYLENE MODERATOR AND POLYETHYLENE REFLECTOR	J. Norris R. Araj
18h	ADJOURN		

### Thursday, 16 December 2021, ICSBEP TRG (Continued)

13h50– 14h00	Join in, test your audio and video, and enjoy a brief chat with colleagues		
14h00 – 15h45	<b>SESSION 9:</b>	<b>APPROVAL OF NEW ICSBEP EVALUATIONS (Continued)</b>	
	ORELA SUB-SPEC-MISC-THERM-000	BENCHMARK OF NEUTRON THERMALIZATION IN GRAPHITE USING THE SLOWING-DOWN-TIME ORELA EXPERIMENT	E. Lee N. Fleming A. Hawari
15h45 – 16h00	BREAK		
16h00 – 17h00	<b>SESSION 10:</b>	<b>REVIEW OF REVISED ICSBEP EVALUATION</b>	
	PU-MET-MIXED-002	TEX PLUTONIUM BASELINE ASSEMBLIES: PLUTONIUM/ALUMINUM METAL ALLOY PLATES WITH VARYING THICKNESSES OF POLYETHYLENE MODERATOR AND A THIN POLYETHYLENE REFLECTOR	C. Percher J. Norris
17h00-17h30	<b>SESSION 11:</b>	<b>CONCLUSION</b>	
		Date for Next Meeting and Completion of Current Handbook	T. Ivanova J. Bess
18h	ADJOURN		