

Update on activities in the NEA Nuclear Science Committee relevant to the NCSP

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With input from

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NCSP Technical Program Review
15th-17th February 2022

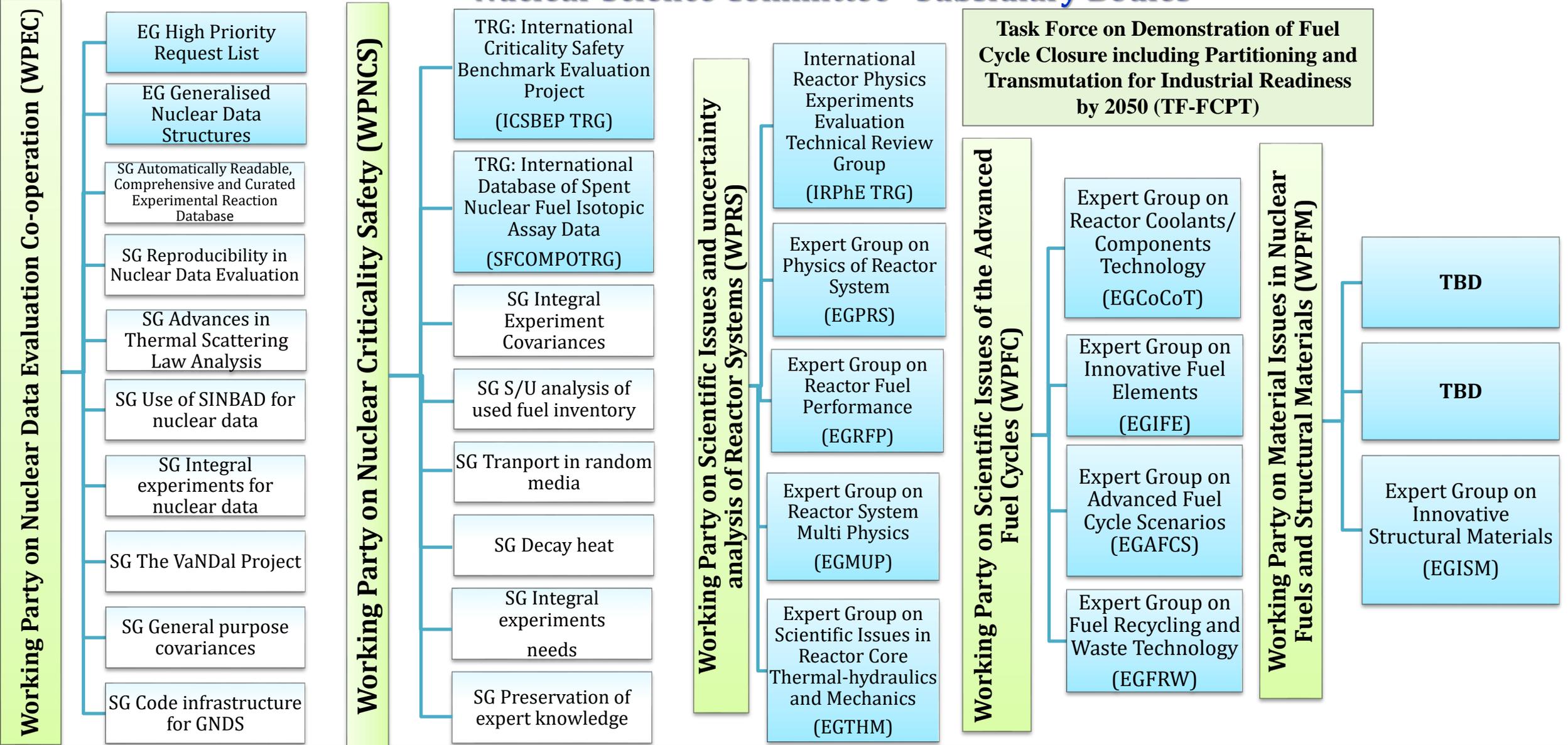
Outline

1. The Nuclear Science Committee (NSC) of the OECD Nuclear Energy Agency (NEA)
2. WPEC activities
3. WPRS activities
4. WPNCS activities

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Nuclear Science Committee - Subsidiary Bodies



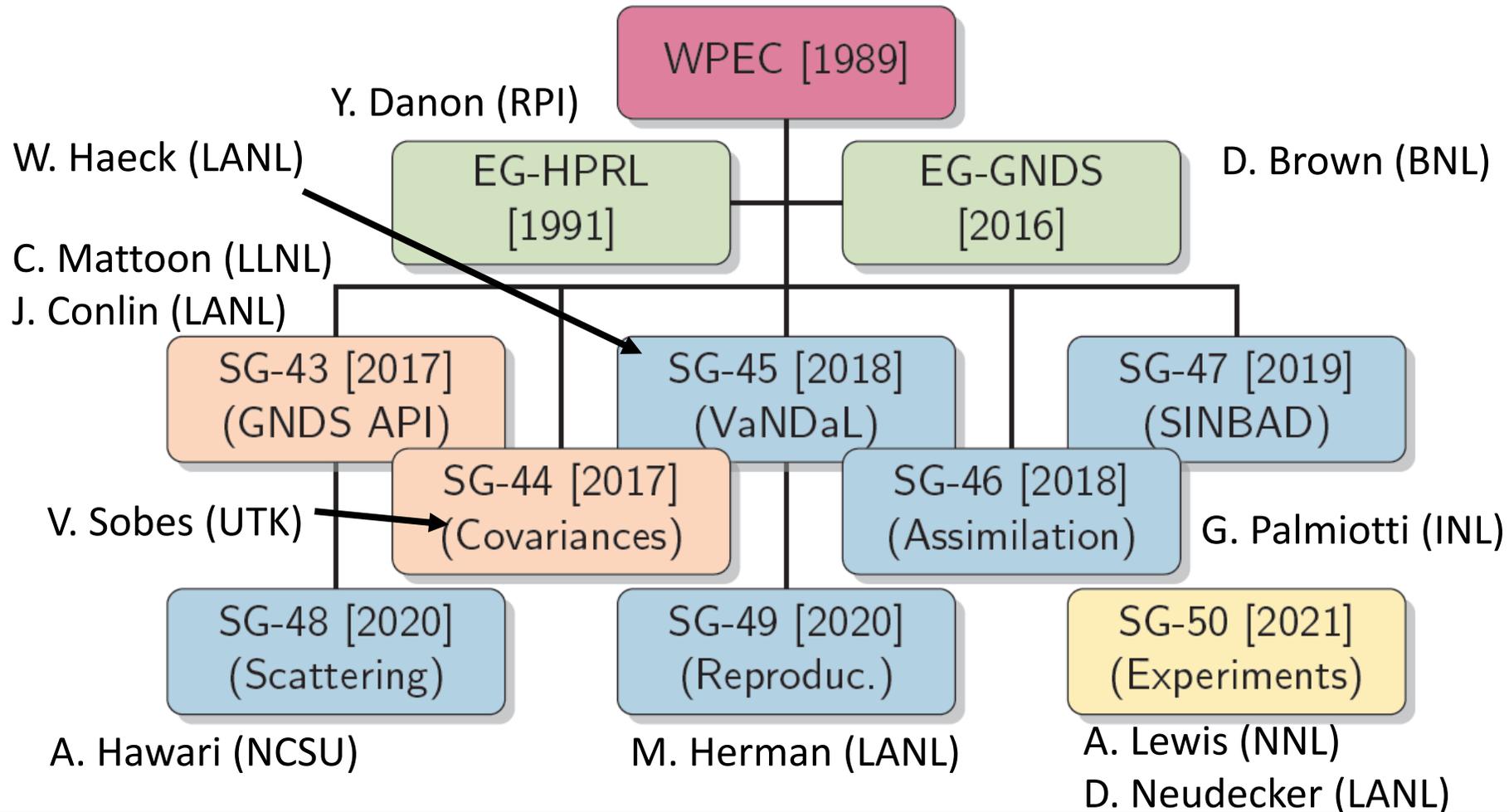
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WPEC overview

Chair: D. Brown (BNL)
Secretariat: M. Fleming (NEA)

(US leadership highlighted)



Subgroup 50: Experimental Database [2021-]

Objective: To develop derived databases from EXFOR that incorporate unofficial corrections and evaluator judgement

- EXFOR has been a uniquely successful database that contains differential experimental data **as published**
 - (Often) not all uncertainties are available (particularly legacy data)
 - Corrections are made by evaluators (who aren't the experimentalists)
 - Some data types are needed in evaluation but not part of EXFOR
 - Ultimately, evaluators weight many data including judgement – which is subjective and certainly not unique
- These (*ex post facto*) data are outside the scope of EXFOR but fundamental to nuclear data evaluation – and often unrecorded
- Plan: three 'layers' that translate into a new format (1), add 'objective' data (2) and allow 'subjective' evaluator input (3)
- Multiple tools released (and open source) since launch
- Very active sub-subgroups working on codes / databases, physics requirements, etc. with ~monthly technical meetings



SG50 Co-ordinators

Dr Amanda LEWIS
Dr Denise NEUDECKER

NNL and LANL, US

Monitor

Professor Arjan KONING

IAEA

EG on Generalised Nuclear Data Structure

Objective: To create and maintain a modern international standard for the storage of nuclear data 'GNDS'

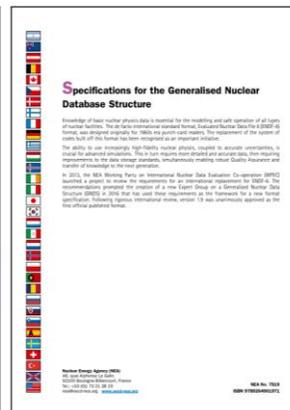
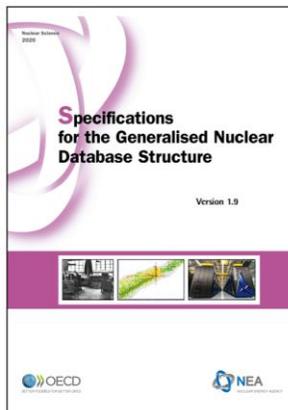
- Subgroup 38 was created to agree the requirements for an international replacement format (which was successful) and start the specifications
- EG-GNDS formed as an official body to finalise the first specifications and create a process for continual updates – **first publication 2020**
- Webinar hosted by NEA on GNDS-1.9, Chaired by NEA DG Magwood and Dr David Brown with international panel
- Following 6 EG-GNDS meetings in 2021 group has endorsed new version 2.0 to be published in 2022



EG-GNDS Chair

Dr David BROWN

BNL, USA



GNDS version 1.9 (first publication) May 2020

ISBN 978-92-6490-197-1

342 page detailed technical specifications

With a policy brief for high-level/general audience

Subgroup 42 (and 48): Thermal Scattering

- **Objective:** To advance the state-of-the-art in thermal scattering evaluated data, processing and validation
- Neutron interactions at eV experience molecular structure – this is a sub-discipline known as ‘thermal scattering’
- Renaissance over past few years with *ab initio* calculation, new measurement techniques and code systems for processing
- **Output of SG42:** 33 new evaluated files including L/H water, UO_2 and FOAK porous graphite, ice, Be(O), Si(O/C), YH, UN – adopted in latest libraries
- **New Subgroup 48 is continuing the collaboration**



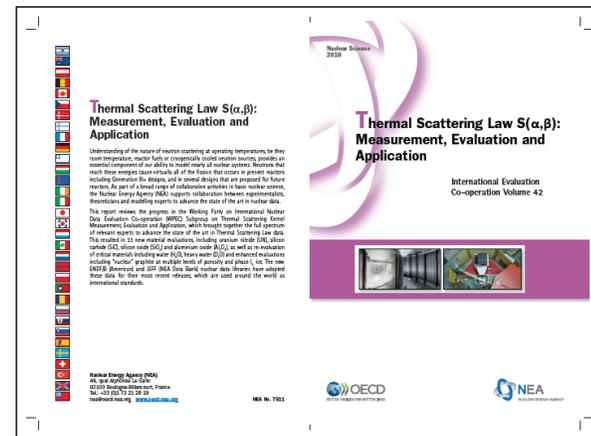
SG42/48 Co-ordinators

Professor Ayman HAWARI

NCSU, US

Dr Gilles NOGUÈRE

CEA, France



NEA No. 7511 Official publication March 2020

Subgroup 47: SINBAD for Validation

Objective: Identify and develop shared resources for SINBAD benchmarks to aid in nuclear data validation and evaluation

- Final meeting December 2021 summarising resources developed, priorities for shielding experiments and methods (e.g. VR, SUQ)
- **Subject of a new Task Force within WPRS/EGPRS (Chair: T. Miller [ORNL])** that will take over responsibility for SINBAD development and act on outputs from this subgroup, preserving knowledge and improving the quality of the shielding ‘benchmarks’
- Outputs will form part of a new Data Bank service to distribute resources for the application of shielding experiments



SG47 Co-ordinator

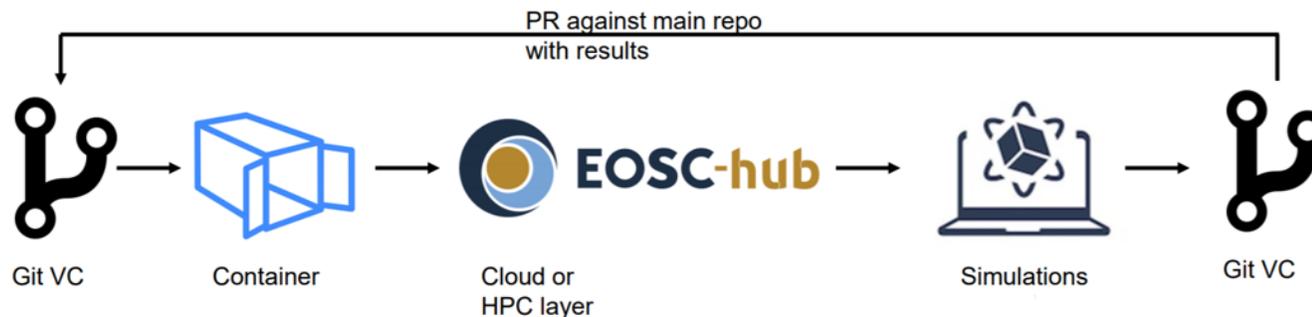
Dr Ivan-Alexander KODELI

UKAEA, UK / JSI, Slovenia

Monitors

Professor Óscar CABELLOS and
Dr Luiz LEAL

UPM, Spain and IRSN, France



Source: A. Davis (UKAEA) SG47 12.2020

EG on High Priority Request List for Nuclear Data

Objective: To maintain a point of reference for nuclear data priorities, including a rigorous process to review and add new entries

- The High-Priority Request List (HPRL) is an online database of experimental and/or evaluation needs
 - Requires a detailed justification with quantification of impact including sensitivity/uncertainty calculations
 - Continuously updated/reviewed with progress and new requests
- HPRL provides reviewed data that funding decision-takers need to determine what research to support
- A new HPRL system (in JCMS) is in development with the new NEA website and will be made public in 2022
- **Complementary to US priority lists**, co-ordinating all worldwide facilities (e.g. JRCs, CERN, JAEA, etc.) on shared priorities



EG-HPRL Chair

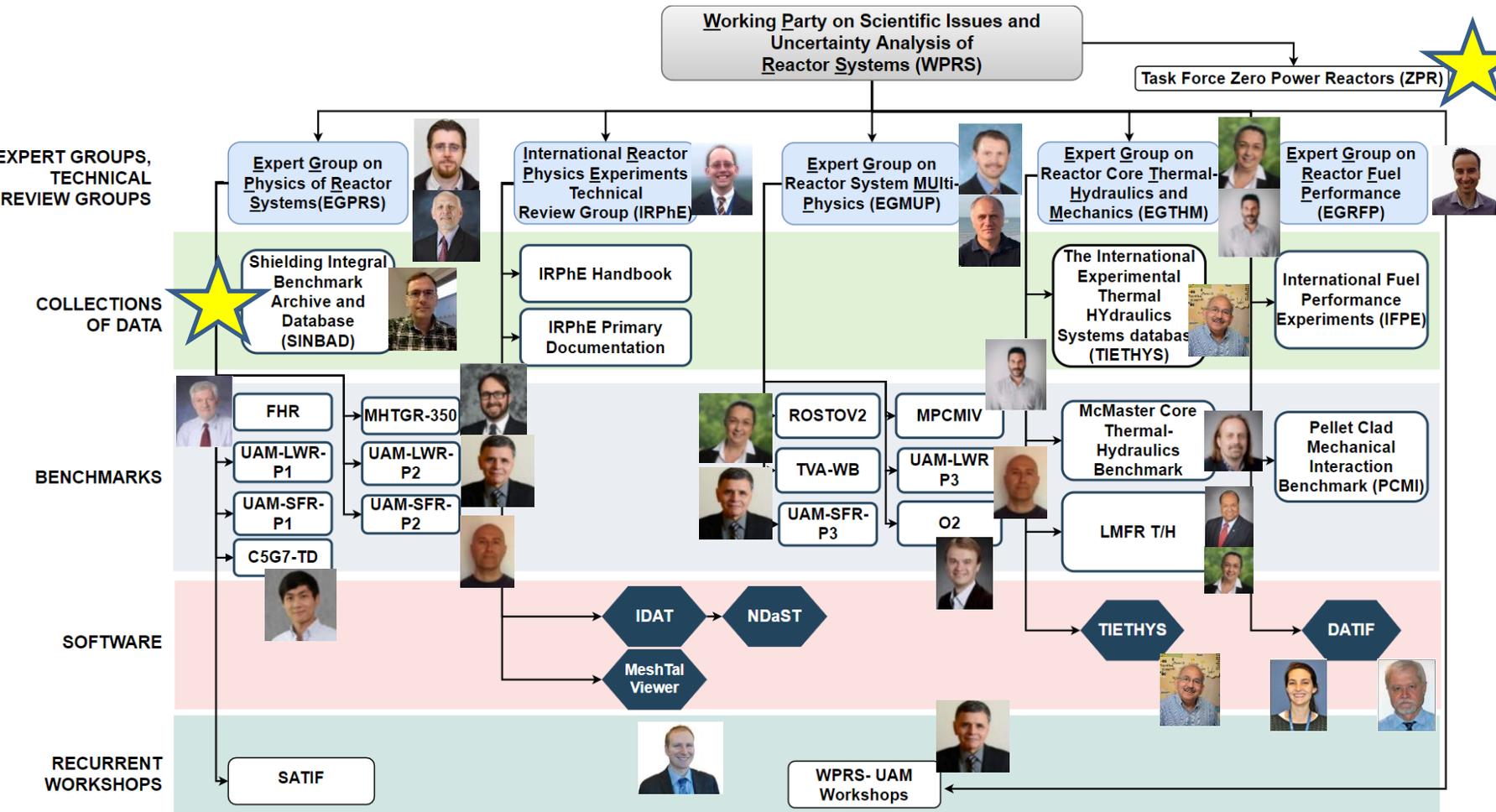
Dr Emmeric DUPONT

CEA, France

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Working Party on Scientific Issues and Uncertainty Analysis of Reactor Systems (WPRS)



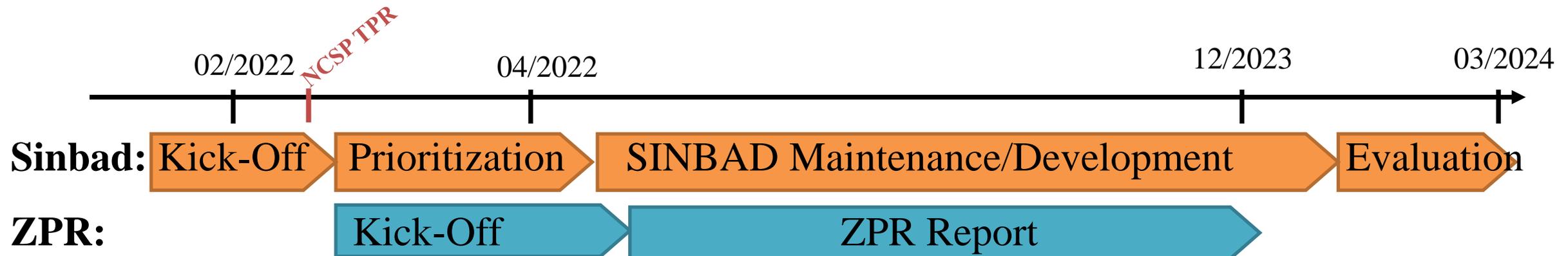
Chairs: K. Ivanov (NCSU, USA),
H. Ferroukhi (PSI, CH)

Key Facts WPRS:

- 16 Delegations + IAEA/EU
- >100 participants in 02/2022 meeting
- 16 benchmark phases
- 8 days of benchmark workshops in 2021
- Next meetings:
21/02 – 25/02: WPRS Meeting
30/05 – 03/06: WPRS Workshops

WPRS News – SINBAD and ZPRs

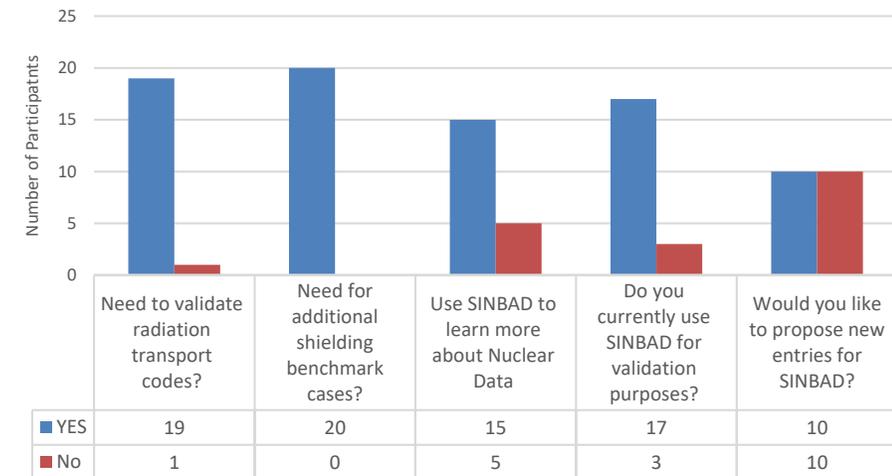
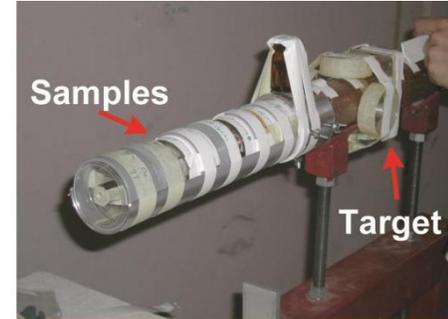
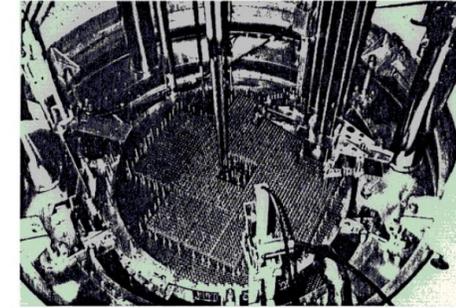
- **ZPRs** – coord. R. Jacqmin (CEA): new task force to provide overview on current status of Zero Power Reactor Facilities (ZPRs)
 - Prospective Needs for Physics Experiments / V&V
 - Requirement Analysis / Gap Analysis
 - Risks and Opportunities
- **SINBAD** – coord. T. Miller (ORNL): new task force to maintain and develop Shielding Integral Benchmark Archive and Database (SINBAD, NEA/RSICC)



SINBAD Task Force

Coordinator T. Miller (ORNL)

- **Shielding Integral Benchmark Archive and Database (SINBAD), a joint RSICC/NEA database**, contains 102 compilations for experiments related to:
 - reactor shielding
 - fusion neutronics shielding
 - accelerator shielding experiments.
- **Collaborative maintenance effort based on NEA Gitlab**
 - At kick-off: 34 participants of 19 institutions of 9 NEA member countries + IAEA + CERN
- **Goals:**
 - **Identify new fission, fusion, and accelerator experiments** that can lead to quality benchmarks
 - **Document benchmarks in standardized format** (similar ICSBEP)
 - **Provide accurate models:** CAD or code agnostic format, materials, sources, detector response parameters
 - **Provide supplemental resources:** sample code outputs, variance reduction parameters, tools to convert data to code input
- Next meetings: 4th March 2022 (priority list) and 25th March 2022 (gitlab)



oe.cd/nea-sinbad

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Working Party on Nuclear Criticality Safety (WPNCS)

Chair: A. Vasiliev (Switzerland)

US leadership role highlighted



Technical Review Group for the International Assay Data of Spent Nuclear Fuel Database (SFCOMPOTRG)

Chair: G. Ilas (US)

Scope

For nuclide inventory of used fuels experiments:

- Maintaining an inventory of the experiments that have been carried out and documented
- Archiving the primary documents and data released in computer-readable form
- Promoting the use of the format and methods developed and to seek to have them adopted as a standard.

And expand to decay heat of used fuels measurements.

Database

- 24k measurements on 750 samples from 44 reactors



Technical Review Group for the International Criticality Safety Benchmarks Evaluation Project (ICSBEPTRG)

Chair: J. Bess (US)*

Scope

For criticality safety experiments:

- Maintaining an inventory of the experiments that have been carried out and documented
- Archiving the primary documents and data released in computer-readable form
- Promoting the use of the format and methods developed and to seek to have them adopted as a standard.

Database

- 2021 Edition of ICSBEP: 587 experimental series from 19 countries, Handbook of ~80000 pages

Subgroups: Short duration groups with very focused objective, for completion within two years. Activity can take the form of a comparison exercise, exchange of good practices, survey of countries and analysis of results, etc. Outcome is a report gathering the results, analysis, main conclusions and recommendations.



Subgroup 5 on experimental needs for criticality safety purposes

2018-2021

Coord.: C. Percher, G. McKenzie (US)

Monitor: T. Tamamoto (JPN)

Subgroup 10 on nuclear data uncertainties quantification on spent fuel inventories

2021-2023

Coord.: C. Carmouze, R. Ichou (FR)

Monitor: G. Ilas (US)



Subgroup 8 on preservation of expert knowledge and judgement applied to criticality benchmarks

2019-2021

Coord.: W. Wieselquist (US)

Monitor: J. Bess (US)

Subgroup 11 on bias and correlated data, comparison of methods

2021-2023

Coord.: A. Hoefler (GER)

Monitor: M. Stuke (GER)



Subgroup 9 on transport in random geometries

2021-2023

Coord.: A. Zoia, C. Larmier (FR)

Monitor: F. Brown (US)

Subgroup on Decay Heat of Spent Nuclear Fuels

2022-2024

Coord.: D. Rochman (CH)

Monitor: O. Cabellos (SPN)

ICNC conference
Oct. '23 @ Sendai, Japan

**Outgoing chair. Nominations for new chair and vice-chair to be sent to ian.hill@oecd-nea.org and julie-fiona.martin@oecd-nea.org by 31st March 2022*



SG5 on Experimental needs for criticality safety purposes

Coordinators: C. Percher, G. McKenzie (US), I. Duhamel (FR) **Monitor:** T. Yamamoto (JPN)

2018-2021

Topic/program of work

- Assess and prioritize the needs of integral experiments and identify the available experimental facilities where integral experiments could be performed.

Deliverables

- Survey of identified needs among participants: complete
 - Summary report: being finalised, to be submitted to NEA early 2022
-
- **Supporting experimental capacities is key to fulfill identified experimental needs, as well as preserve know-how and training opportunities**
 - **WPNCs SG5 has committed to providing support to the ZPR task force under WPRS**

SG8 Preservation of Expert Knowledge and Judgement Applied to Criticality Benchmarks



Coordinator: W. Wieselquist (US), **Monitor:** J. Bess (US)
2018-2021

Topic/Program of work

- Develop a methodology for collecting and disseminating feedback on evaluations from qualified experts to better serve users of the ICSBEP benchmarks

Deliverables

- A methodology to collect and assess expert knowledge on ICSBEP benchmarks was derived
- The form was distributed and some feedback received, although a limited amount
- Brief report on methodology being finalized, due S1 2022

Follow up

- Longer term maintenance of the form to keep collecting feedback continuously, to be discussed
 - **Close links with ICSBEPTRG**
 - **Feel free to contribute: <https://code.ornl.gov/ww5/wpncs-sg8-feedback-form>**



SG9 on transport in random geometries

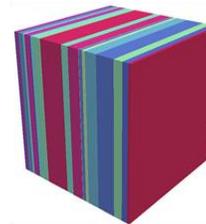
Coord.: A. Zoia (FR), C. Larmier (FR) **Monitor:** F. Brown (US)
2021-2023

Topic/program of work

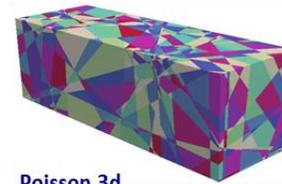
- Investigate the effects of “random geometries” on the key parameters of criticality calculations, with special emphasis on the issue of return to criticality
- Through a comparison exercise involving various randomization procedures

Deliverables

- Specifications were distributed Sept. 2021
- Report providing comparisons of various approaches proposed by several countries will shed light on the impact of the chosen model on the neutron multiplication factor and other key quantities
- Final contributions due July 2022



Poisson 1d



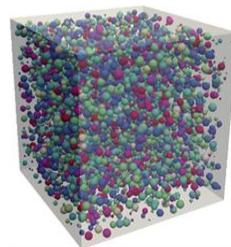
Poisson 3d



Voronoi 3d



Poisson extruded



Spherical inclusions

Court. A. Zoia, 25th WPNCs, July 2021

SG10 on nuclear data uncertainties quantification on spent fuel inventory – Part A



Coord.: C. Carmouze, R. Ichou (FR) **Monitor:** G. Ilas (US)

2021-2023

Topic/program of work

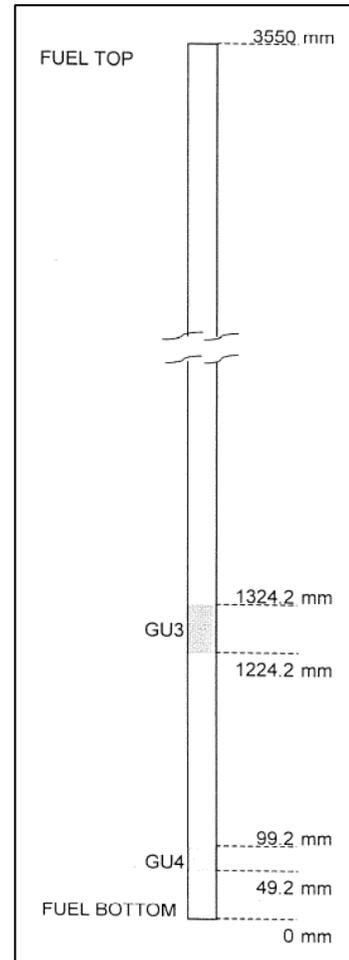
- Comparison exercise that involves nuclear data sensitivity/uncertainty analysis on spent fuel nuclide inventory in order to
 - assess the impact of nuclear data uncertainties (cross-sections, decay data and fission yield) on fuel assembly depletion calculations, and to
 - analyze the contribution of nuclear data uncertainties to the calculation over experiment bias
- Specifications of the exercise (output from SG7) were distributed Sept. '21 and revised Oct. '21

Deliverables

- Specifications, based on SFCOMPO ARIANE GU3 sample, were distributed Sept. 2021
- So far, 14 contributions received (as discussed at the 1st meeting in January 2022), covering wide range of codes and ND libraries
- Final results (best estimate) due March 2022
- Report providing Best-Estimate values computed by participants

Follow-up: Part B (2023-2025)

- Once the best-estimate values are available and well understood, a new exercise focusing on the sensitivity/uncertainty analysis will be implemented



*Court. ARIANE Programme, Irradiation Data Report Part 2
AR99/13, Belgonucléaire 1999*

SG11 on Bias and Correlated Data, Comparison of Methods

Coord.: A. Hoefer (GER) **Monitor:** M. Stuke (GER)

2021-2023

Topic/program of work

- Assess the impact of the selection process of correlated benchmark to validate criticality safety estimates
- A toy exercise to support the understanding of previous benchmark (EGUACSA Phase IV)

Deliverables

- Calculation results for various methodologies and under various assumptions
 - Preliminary results from 5 participants discussed during 1st meeting in January 2022
 - Final results expected early June 2022
- Report providing the analysis of such results

SG12 on spent nuclear fuel decay heat: assessing the confidence level in experimental and computational estimations

Coord.: D. Rochman (CH) **Monitor:** O. Cabellos (SPN)

2022-2024

Topic/program of work

- provide the user community with reliable estimations of decay heat for spent nuclear fuel from existing power plants. Such estimations include best estimates, as well as uncertainties (or covariances) for specific cooling times, relevant for severe accident to long-term repository

Deliverables

- Report (and possibly extended journal paper) on the “state-of-the-art” concerning experimental and simulated decay heat quantities

Follow up

- Subject to the conclusions of the state of the art report, potential analytical benchmark, the use of the SKB-50 data, as well as more general discussions on calorimeter(s)

➤ **Approved in January 2022**

➤ **Kick-off scheduled 15th March 2022**

SFCOMPO TRG Technical Review Group for the International Assay Data of Spent Nuclear Fuel Database



Chair: G. Ilas (US)

- SFCOMPO 2.0 is the largest international database of open experimental radiochemical assay data for spent nuclear fuel - over 700 spent nuclear fuel samples from fuel irradiated in 44 reactors
- Focus of the TRG (2nd meeting in January 2022)
 - collection of experimental data incl. decay heat data
 - WIP on adding publicly available decay heat data
 - Progress on data release by the MALIBU program participants with support of SFCOMPOTRG, in view of adding to the SFCOMPO2.0
 - evaluation of the experimental data and the development of benchmarks and benchmark models
 - 2 in progress: Fukushima Daini 2, BWR samples SF98 and SF99; Gösgen PWR GU4
 - 2 approved: TMI1 assemblies NJ05YU and NJ070G (15x15); Fukushima-Daini1 2F1ZN2 and 2F1ZN3 (9x9)
 - Maintenance of the database and GUI



oe.cd/nea-sfcompo

ICSBEP TRG Technical Review Group for the International Criticality Safety Benchmarks Evaluation Project icsbep.inl.gov || oe.cd/nea-icsbep

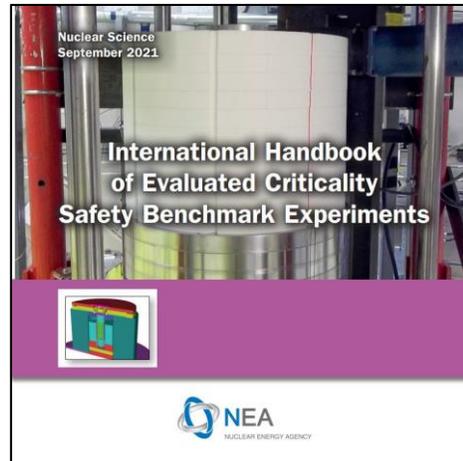
Chair: J. Bess (US) (stepping down) – New chair to be designated in 2022

The ICSBEP continues to provide high-quality integral benchmark data

- Valuable data for validation of nuclear data and neutronics modeling and simulations
 - recently highlighted was the Swedish approval for storage of used fuels; for which DICE helped identify cases relevant to support the safety demonstration
- Data and expertise contributed from 26 countries
- Enable current and future activities involving experimental validation

2021 Edition

- Following TRGs end of 2020
- ~80,000 pages, 587 Evaluations, incl. 5 new and 10 rev.
- finalized pending publication
- DICE, Database for ICSBEP maintained and annually released



2022 Edition

- Annual meeting in Oct. + Dec '21
- ~80 participants
- 10 new evaluations (7 approved) + 1 rev.

Next ICSBEP TRG: October. 2022

Nominations for both chair and vice-chair to be sent to ian.hill@oecd-nea.org and julie-fiona.martin@oecd-nea.org by **31st March 2022**

WPNCs highlights

- Groups finalizing their work
 - SG5 on Integral Experimental Needs for Nuclear Criticality Safety
 - SG8 on Preservation of Expert Knowledge on Criticality Benchmarks
- Groups newly launched
 - SG9 on Transport in Random Geometries
 - SG10 on Nuclear Data uncertainties in inventory calculations
 - SG11 on Bias and correlated data
 - SG12 on Decay heat of irradiated nuclear fuels
- New chairpersonship of ICSBEP TRG will be designated in 2022
 - **Nominations** to be sent to ian.hill@oecd-nea.org and julie-Fiona.martin@oecd-nea.org by **31st March 2022**
- Upcoming meetings
 - WPNCs week 27th June – 1st July 2022
 - D. Bowen was kindly invited by the WPNCs members to provide an overview of NCSP activities and methods of work at the upcoming WPNCs meeting in view of further strengthening co-operation between NCSP and WPNCs
 - ICSBEPTRG week in October 2022 (exact dates TBD)
 - **Save the date**, ICNC conference, Oct. 1-6 2023 @ Sendai, Japan

> **Key in-kind contribution from the NCSP to support the activities of the WPNCs**

**The NEA is grateful for
the notable support of the NCSP
for the US representation in NSC groups**

Thank you for your attention



All NEA publications and institutional documentation available at
www.oecd-nea.org

