NEA
NUCLEAR ENERGY AGENCY

Integral benchmark activities for radiation transport under the auspices of the NEA Nuclear Science Committee

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Technical Meeting on the Compilation of Nuclear Data Experiments for Radiation Characterization
IAEA, October 10, 2022

Outline

i. The NEA Nuclear Science Committee (NSC)

ii. NSC activities related to integral benchmark activities

   i. ICSBEP, SINBAD, IRPhE, SFCOMPO Databases and related Software Tools

   ii. WPRS Reactor Single- & Multi-Physics Benchmark Activities

   iii. ZPR Task Force

   iv. Nuclear Data Sensitivity Tool (NDaST)

iii. Updates @NEA DB

iv. Conclusions

Objectives

1. Provide overview on the NEA integral benchmark activities in the domain of radiation transport
2. Give overview on NEA infrastructure for maintaining the databases
3. Highlight related initiatives
4. Discuss future cooperation with the CoNDERC project

The NEA mission

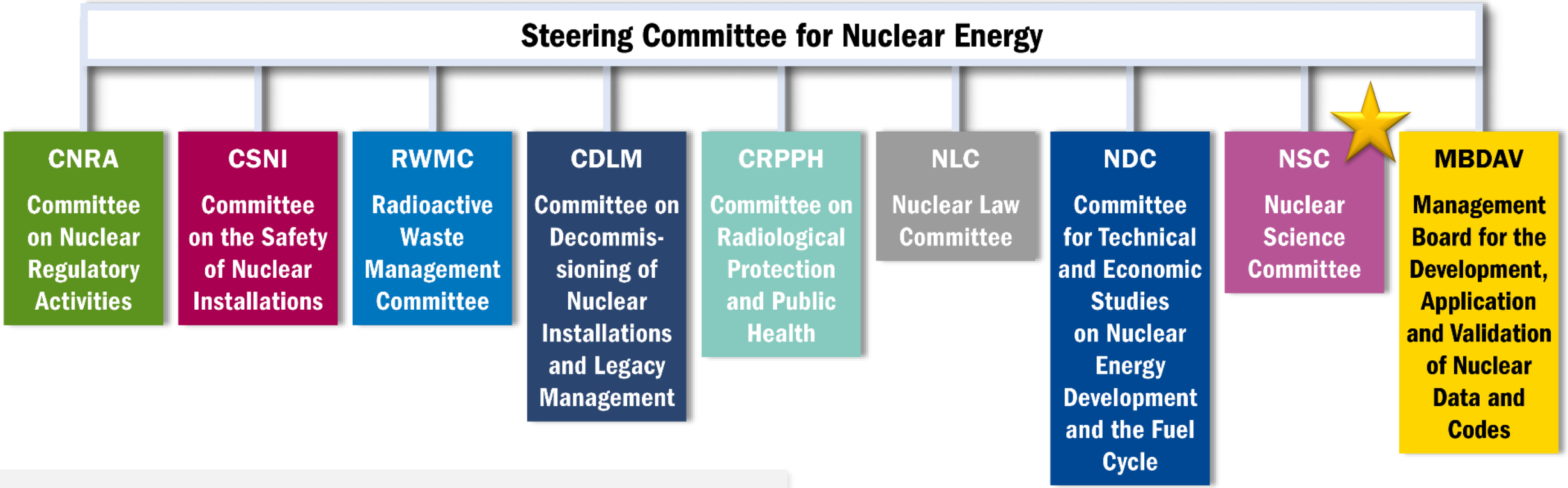
To assist its member countries in maintaining and further developing, through **international co-operation, the scientific, technological and legal bases** required for a safe, environmentally sound and economical use of nuclear energy for peaceful purposes.

To provide authoritative assessments and to forge **common understandings** on key issues as **input to government decisions on nuclear energy policy** and to broader OECD policy analyses in areas such as energy and the sustainable development of low-carbon economies.

NEA member countries

The NEA's current membership consists of 34 countries in Europe, North America and the Asia-Pacific region. Together they account for approximately 82% of the world's installed nuclear capacity.

NEA committees (as of 1 January 2022)

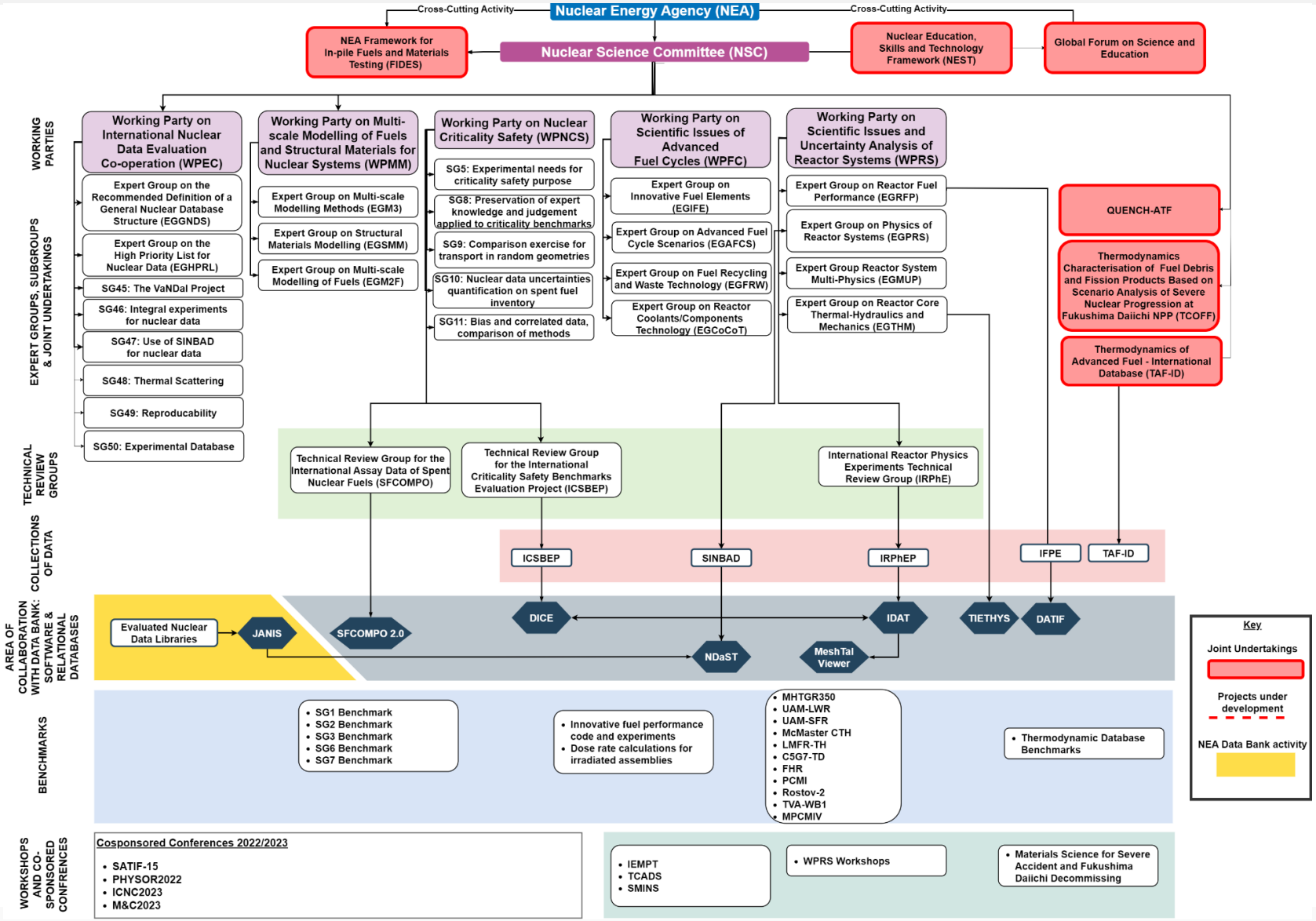


8 standing technical committees

1 management board

74 working parties and expert groups

Nuclear Science Committee

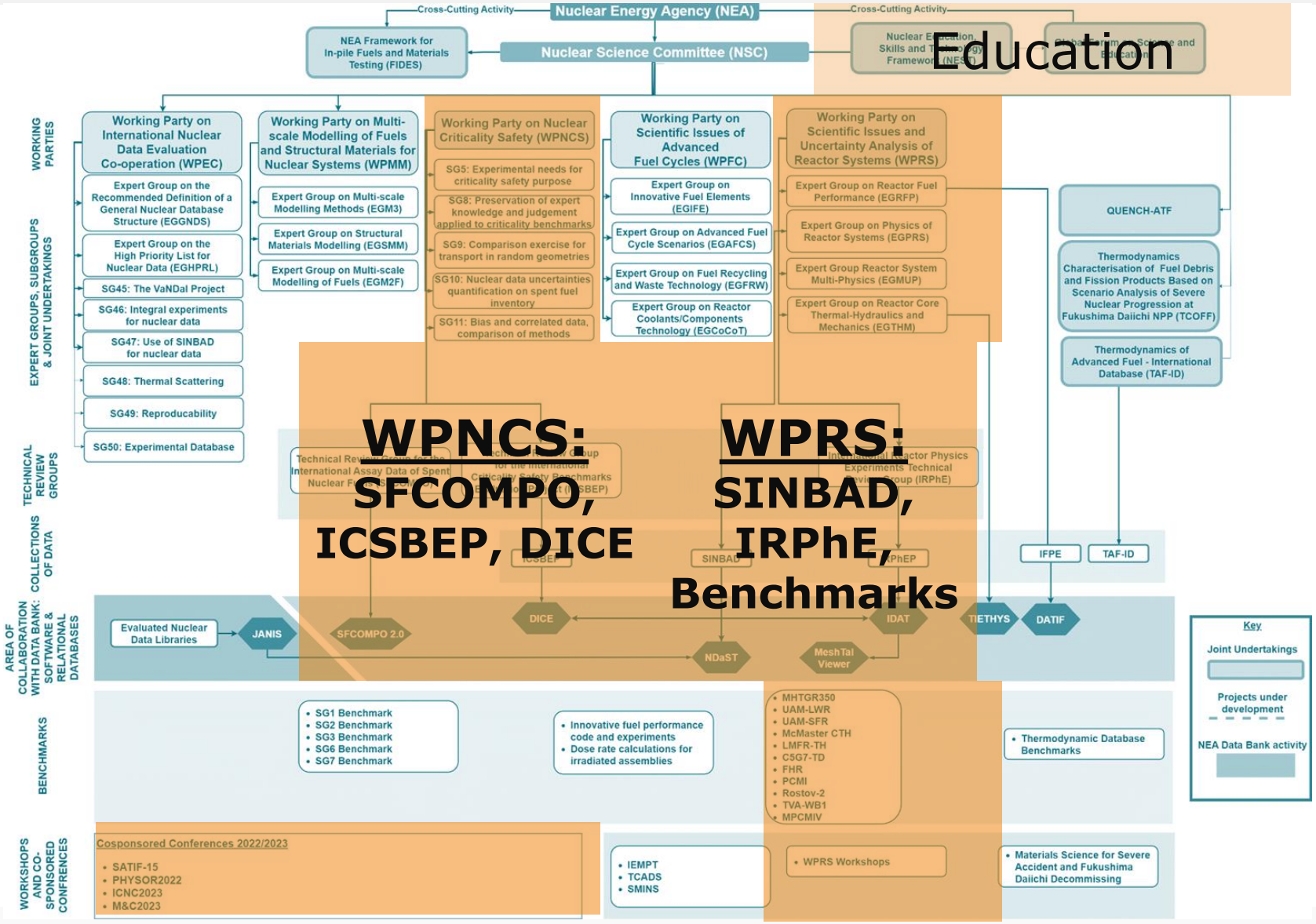


Working Parties and Expert Groups…

- provide member countries with up-to-date information, preserve knowledge, develop consensus
- **supervise data collections and associated software tools.**
- **organize international benchmarks** challenging state-of-the-art simulation methods on radiation transport.
- **organize conferences** related to integral bencharks (SATIF, WPRS Benchmarks Workshop).
- are involved in related **education activities.**

Nuclear Science Committee

This Talk



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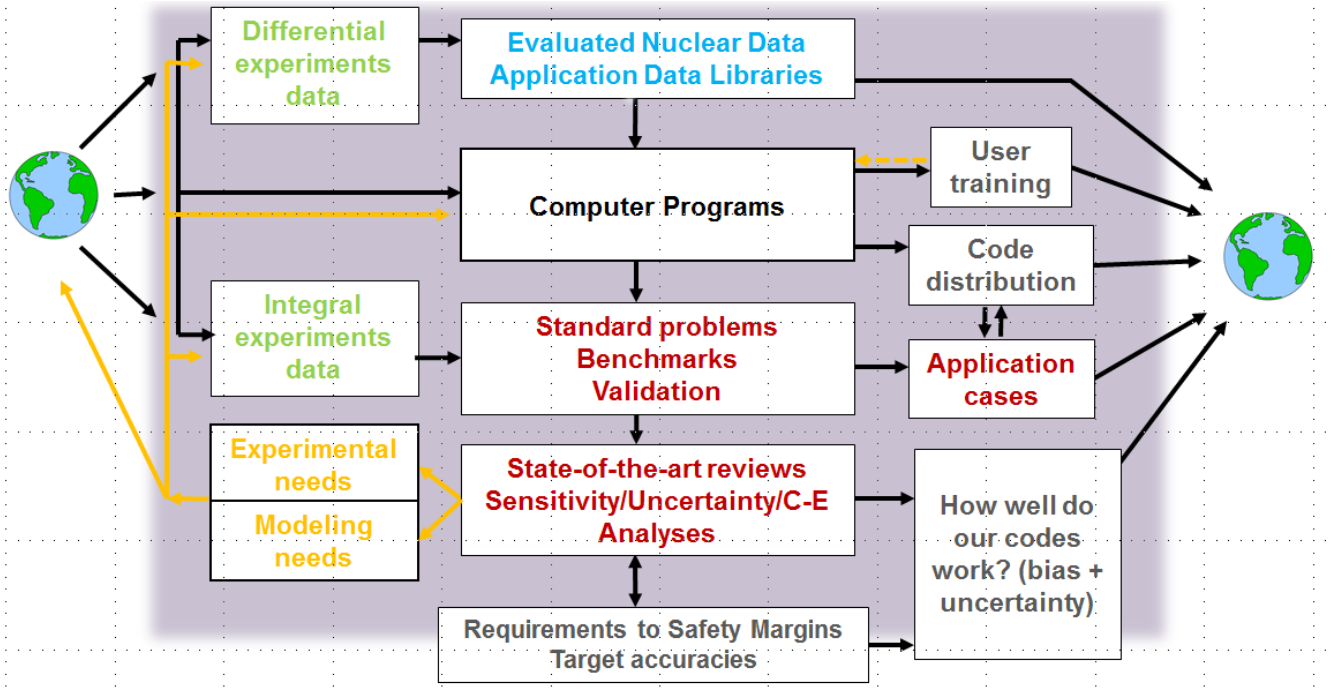
Motivation: Need for Databases & Feedback



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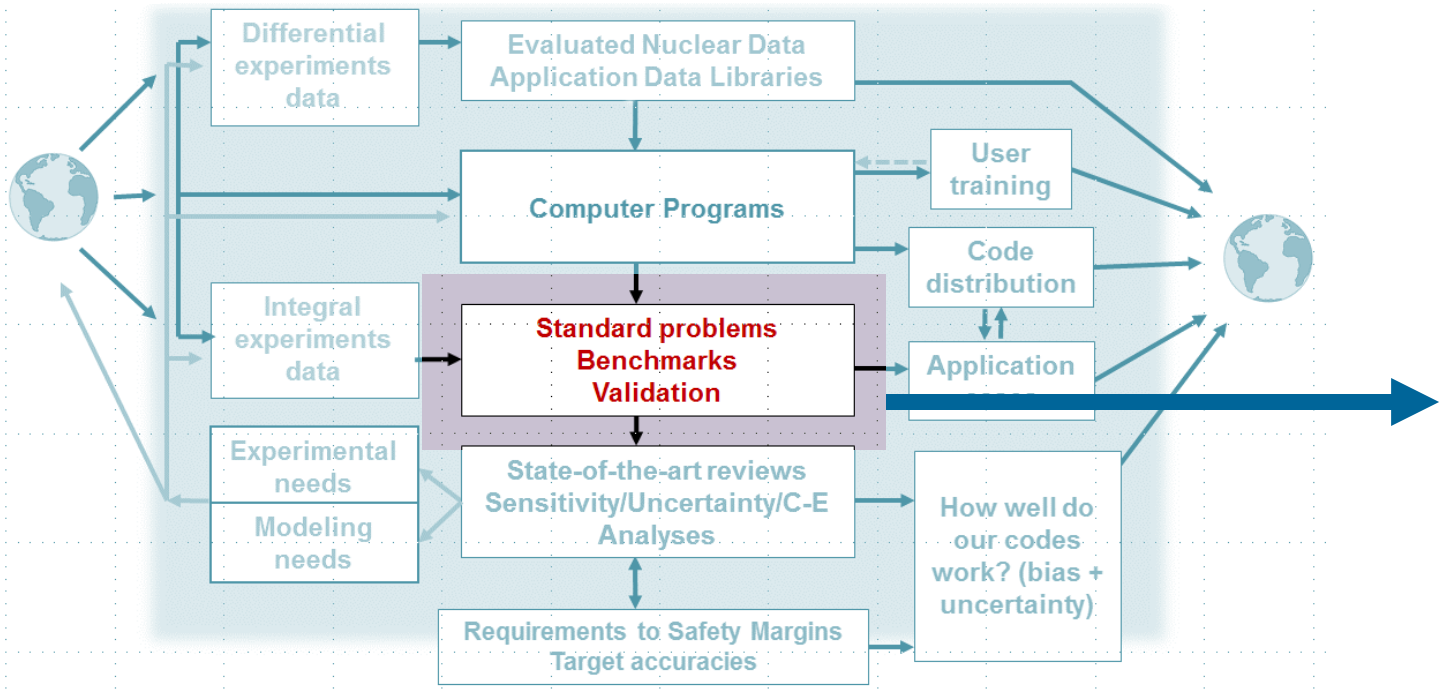
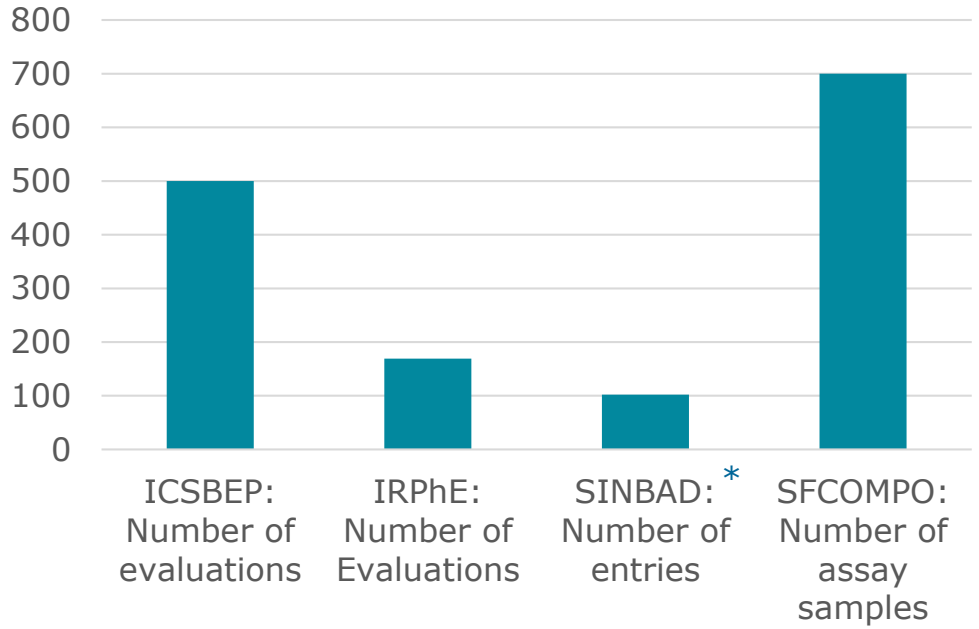


NEA Databases:

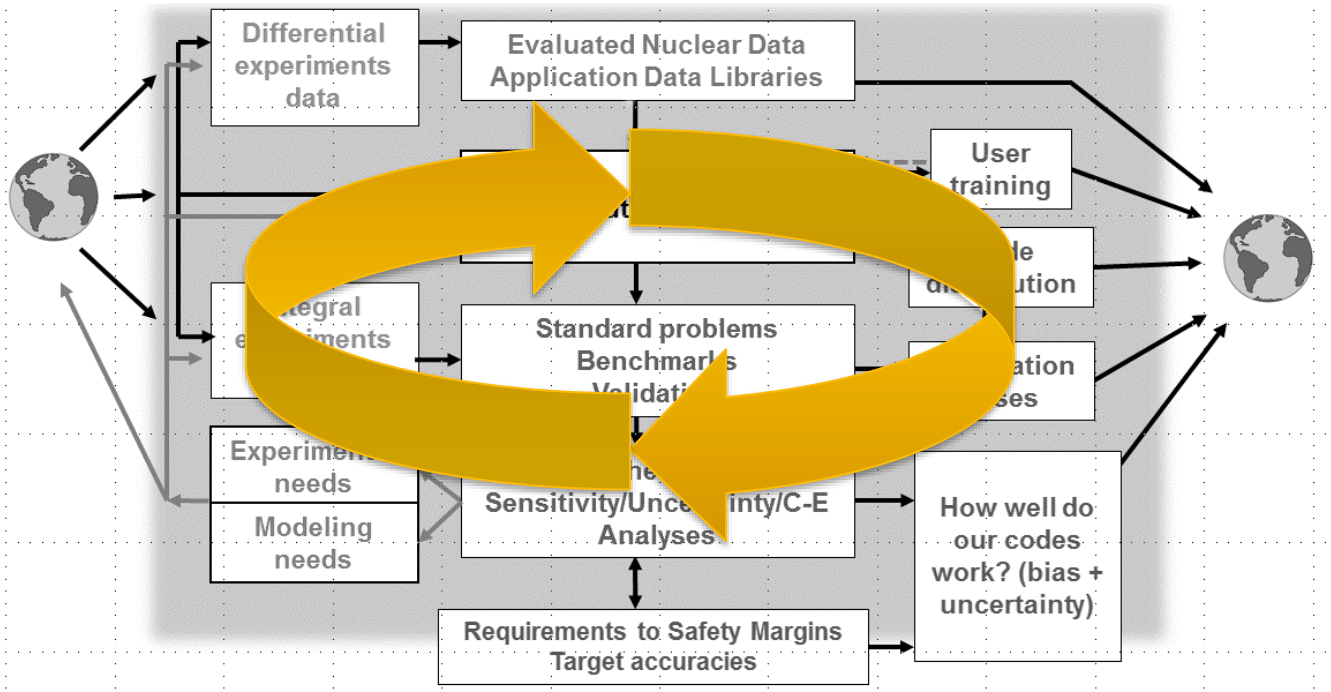


*In cooperation with RSICC

Quality

+ Other NEA Benchmark Initiatives

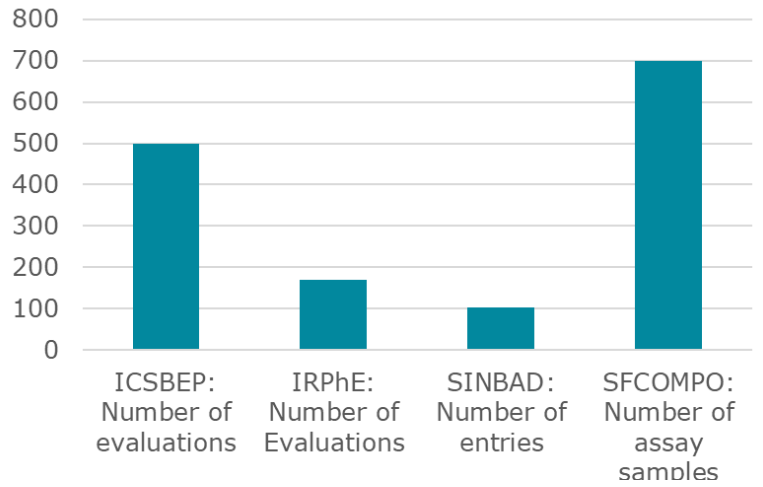
Motivation: Need for Databases & Feedback



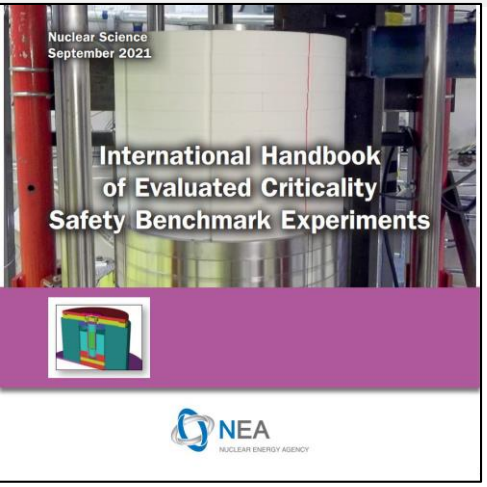
Feedback mechanisms

- **Assessments of needs** with respect to basic data, methods, and V&V in NEA bodies
- **Quantitative feedback** with rapid feedback tools linking sensitivity profiles and integral experiments/applications
  - Large speed-up of feedback loop changed months into minutes
  - Immediate analysis of change
  - Quick checks in CI workflow
  - Indications to start dedicated analyses
  - E.g.: NDasT (NEA), ADVANCE (BNL), CRATER (LANL), …

ICSBEP, SINBAD, IRPhE, SFCOMPO Databases and related Software Tools



ICSBEP TRG - Technical Review Group for the International Criticality Safety Benchmarks Evaluation Project



The ICSBEP continues to provide high-quality integral benchmark data

- **Valuable for nuclear data testing, uncertainty reduction, criticality safety, reactor physics, advanced modeling and simulation**
- Data and expertise contributed from **26 countries**
- Enable current and future activities supported by experimental validation

Chair: Catherine Percher (USA),
Vice Chair: B.J. Marshall (USA)
NEA Secretariat: J.-F. Martin

2021 Edition

- Following TRGs end of 2020
- ~80,000 pages, 587 evaluations, incl. 5 new and 10 rev.
- To be published soon
- 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: November 2022 and April 2023

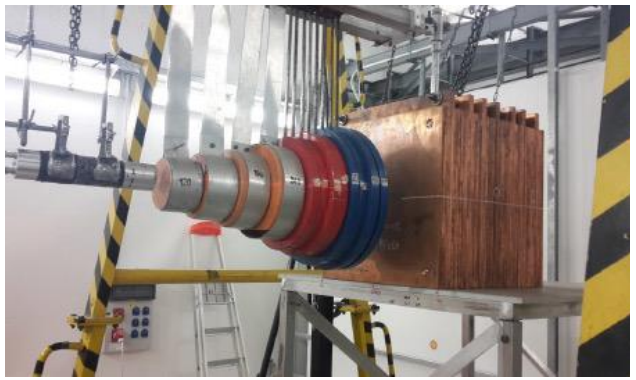
oe.cd/nea-icsbep

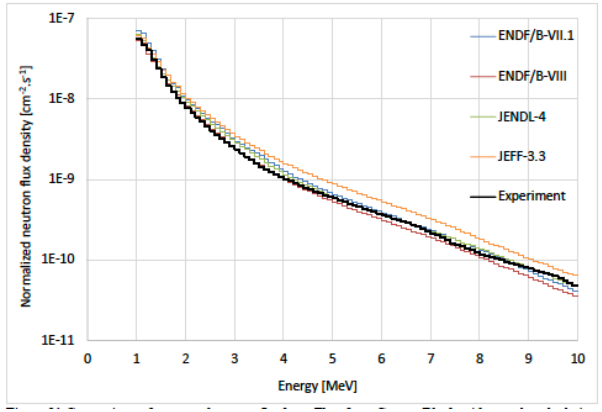
Recent additions to the Handbook relevant to radiation characterization

Approved late 2021, under edition, to be published early 2023

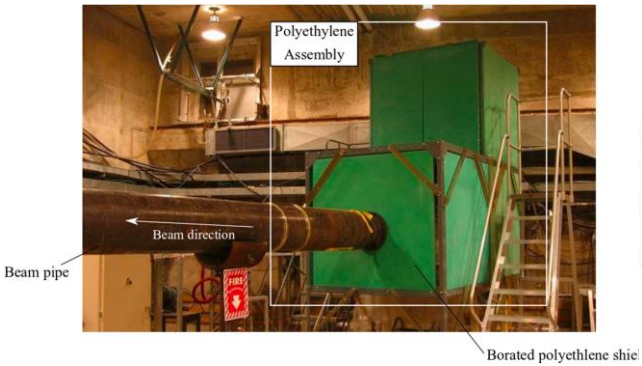
ALARM-CF-CU-SHIELD-001

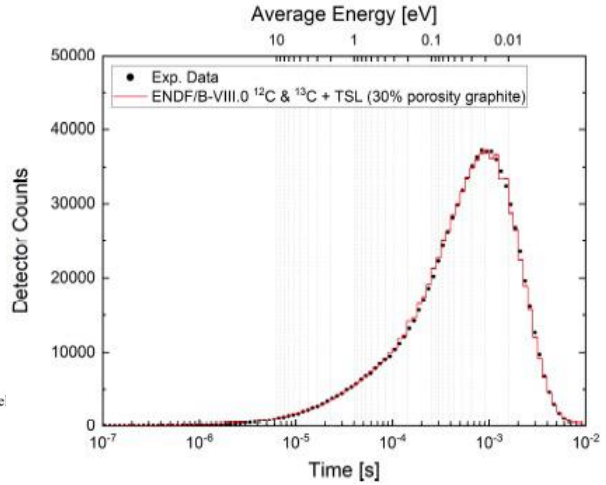
Measurement of Fast Neutrons Leakage Spectra from Copper Block with Cf-252 Source in Center
– Performed @ Research Center Rez
– Measured proton recoil spectra to obtain neutron leakage flux/spectra
– Useful to test the validity of neutron cross section data





FUND-ORELA-ACC-GRAPH-PNSDT-001

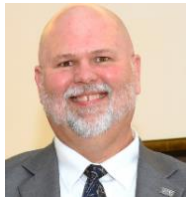




Benchmark of Neutron Thermalization in Graphite using the Slowing-Down-Time ORELA Experiment
– Oak Ridge Electron Linear Accelerator Facility
– Nuclear graphite pile
– Useful to test thermal scattering law data

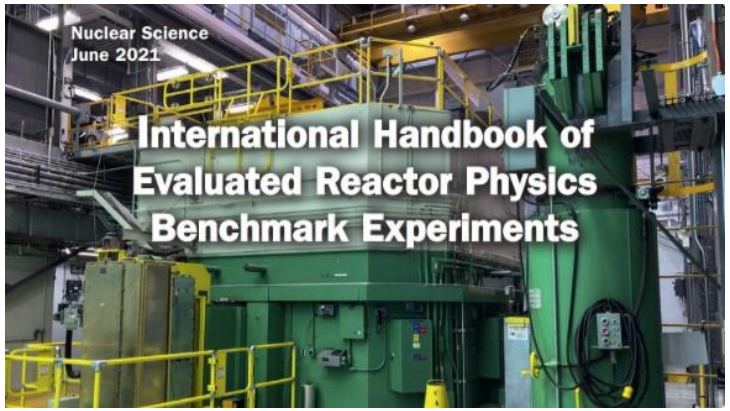
IRPhE TRG - International Handbook of Evaluated Reactor Physics Benchmark Experiments Technical Review Group

Continuous update of IRPhE and IRPhE Database and Analysis Tool (IDAT)



New Chair: Mark DeHart (USA)
New Vice Chair: TBD
NEA-Secretariat: Ian Hill

- TRG Meeting was held in December 2021 :
  - IPEN evaluation on kinetics parameters and reactivity effects
  - Revision to ZPPR evaluations to clarify drawer orientation
  - Updates on TVA-WB1 and MPCMIV benchmark evaluations
- Next meeting is scheduled to be held in April 2023 in conjunction with the ICSBEP TRG.
- NEA continues to maintain the relational database tool to search the Handbook: www.oecd-nea.org/idat



Next Handbook Edition:

- 23 Participating Countries
- 56 Reactor Facilities
- Data from 169 Experimental Series
  - 165 Approved Benchmarks
  - 4 DRAFT Benchmarks
- Available End of 2022

https://oe.cd/IRPHE

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

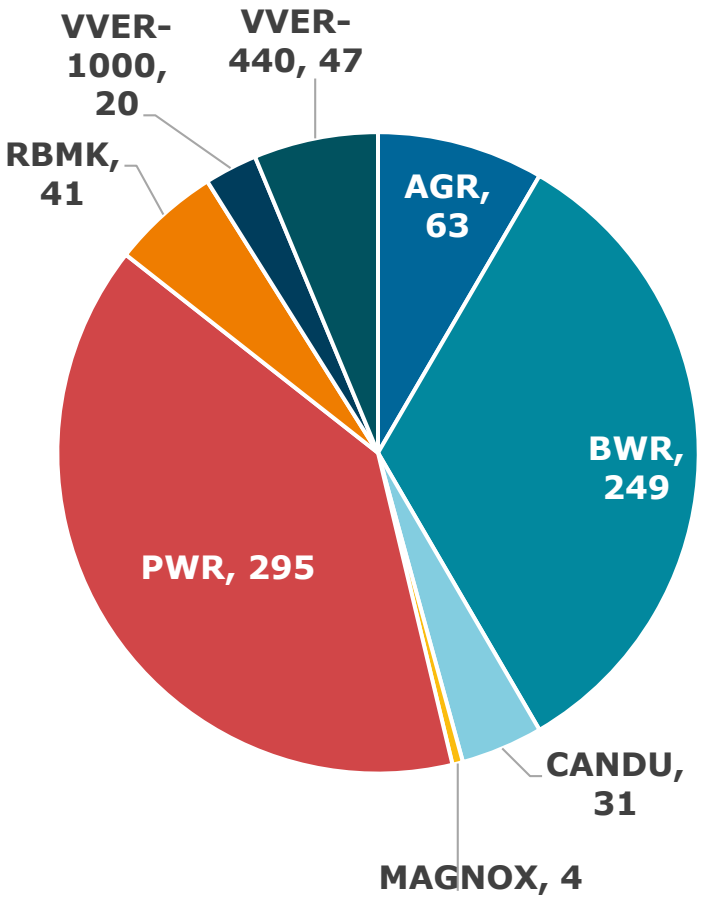
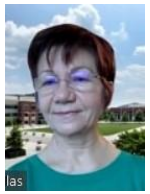


Figure: Number of spent nuclear fuel samples per reactor type in SFCOMPO (2017 edition)

- 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:
  - collection of experimental data incl. decay heat data
    - Work in progress on **adding publicly available decay heat data**
    - Progress on data release by the MALIBU program participants with support of SFCOMPO TRG, 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



Chair: G. Ilas (USA)
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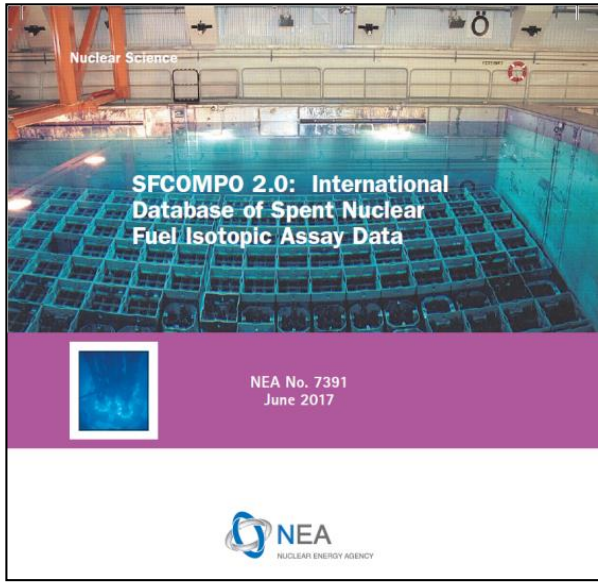

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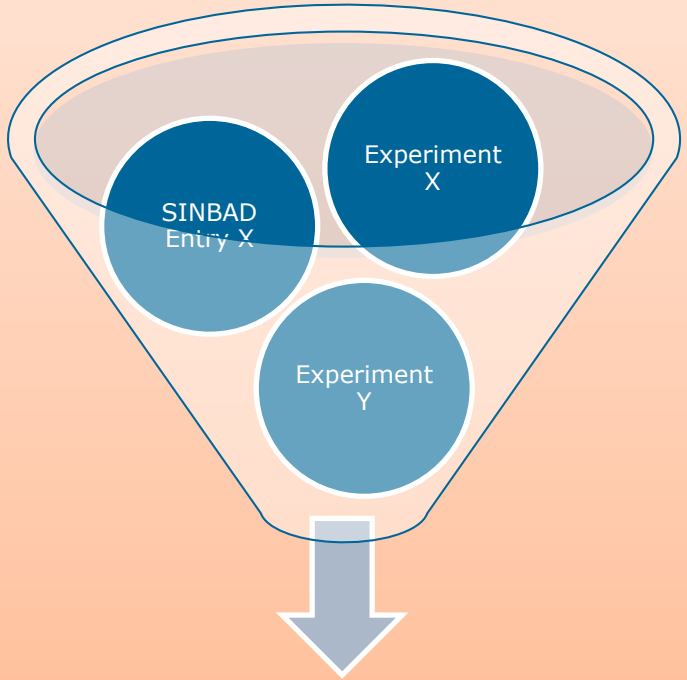
Shielding Benchmarks: ICSBEP and SINBAD

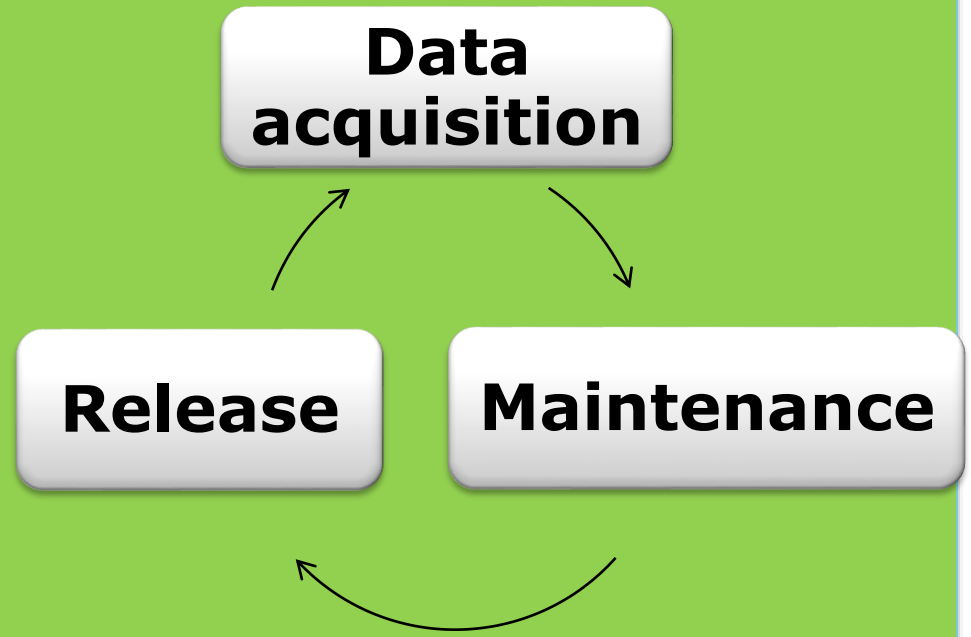
ICSBEP Process:



Evaluated Shielding Experiment Entry in ICSBEP Volume VIII

- ICSBEP includes only experimental benchmarks with thoroughly evaluated uncertainties by ICSBEP TRG
- Other data stored in SINBAD

New Iterative Process for SINBAD:

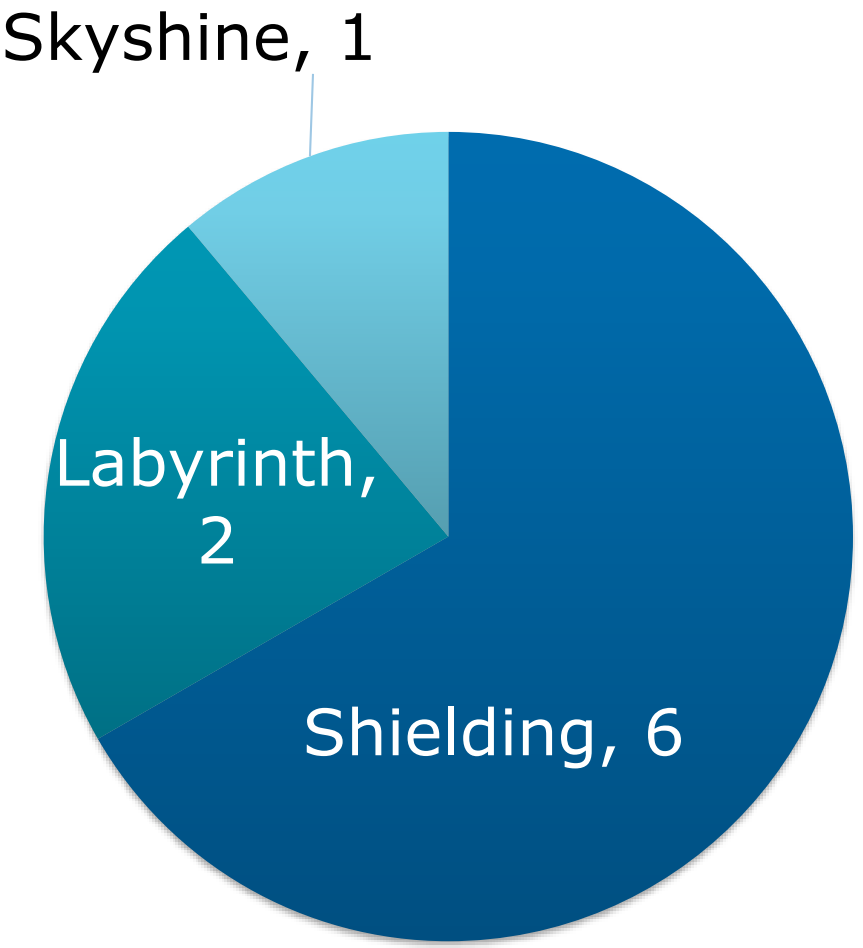


➔ **Towards SINBAD as independent, reviewed database with datasets at different maturity levels with continuous releases**

ICSBEP Volume 8: Criticality Alarm / Shielding Measurements

- **Quality control: all experimental data are thoroughly evaluated and internationally peer-reviewed**
- Started in 2005 by the NEA ICSBEP TRG, Blair Briggs and others
- Distributed by OECD/NEA
- **Experimental Benchmarks:**
  - **Neutron and photon leakage spectra from CF-252 source** at centre of
    - 40-cm diameter **iron sphere**
    - six **iron spheres** of different diameters
    - six **lead spheres** of different diameters
  - **Neutron activation foil and thermoluminescent dosimeter responses to a**
    - **bare,**
    - **polyethylene, and**
    - **lead**

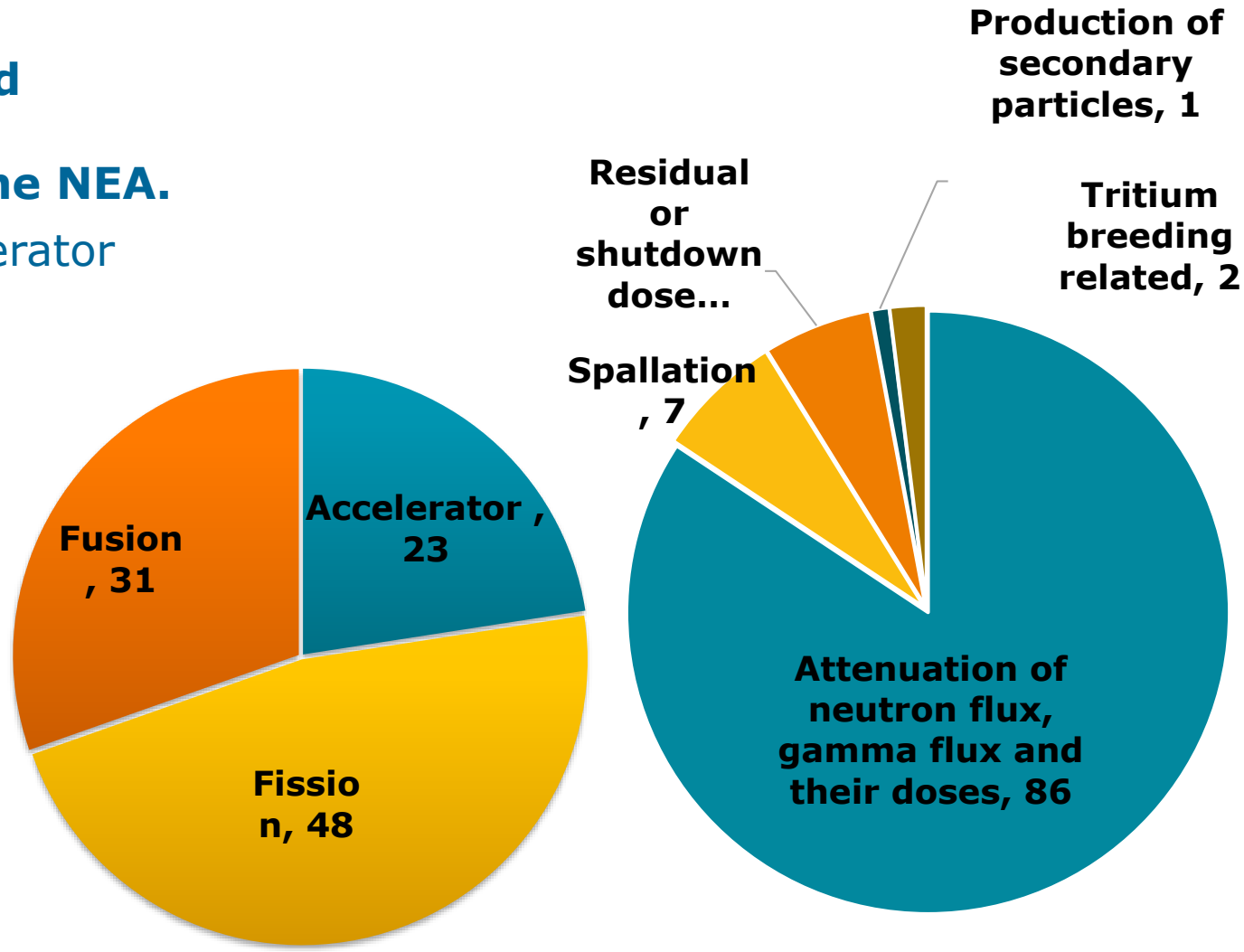
    reflected pulse of the CEA Valduc Silene critical assembly
  - **Neutron fields in** three-section **concrete labyrinth** from CF-252 source
  - **Baikal-1 skyshine** experiment



SINBAD - Shielding Integral Benchmark Archive and Database

- **Work jointly carried out by the United States' Radiation Safety Information Computational Center (RSICC) and the NEA.**
- 102 reactor, fusion neutronics, and accelerator shielding experiments
- Started in 1992 by OECD/NEA Databank and ORNL/RSICC by E. Sartori, B. Kirk, I. Kodeli, and others
- Quality reviews performed for approx. 50% of entries*
- Distributed by OECD/NEA and ORNL/RSICC

oe.cd/nea-sinbad



* See "SINBAD – Radiation shielding benchmark experiments", Kodeli and Sartori, Annals of Nuclear Energy, Volume 159, 108254

SINBAD - Motivation for Change

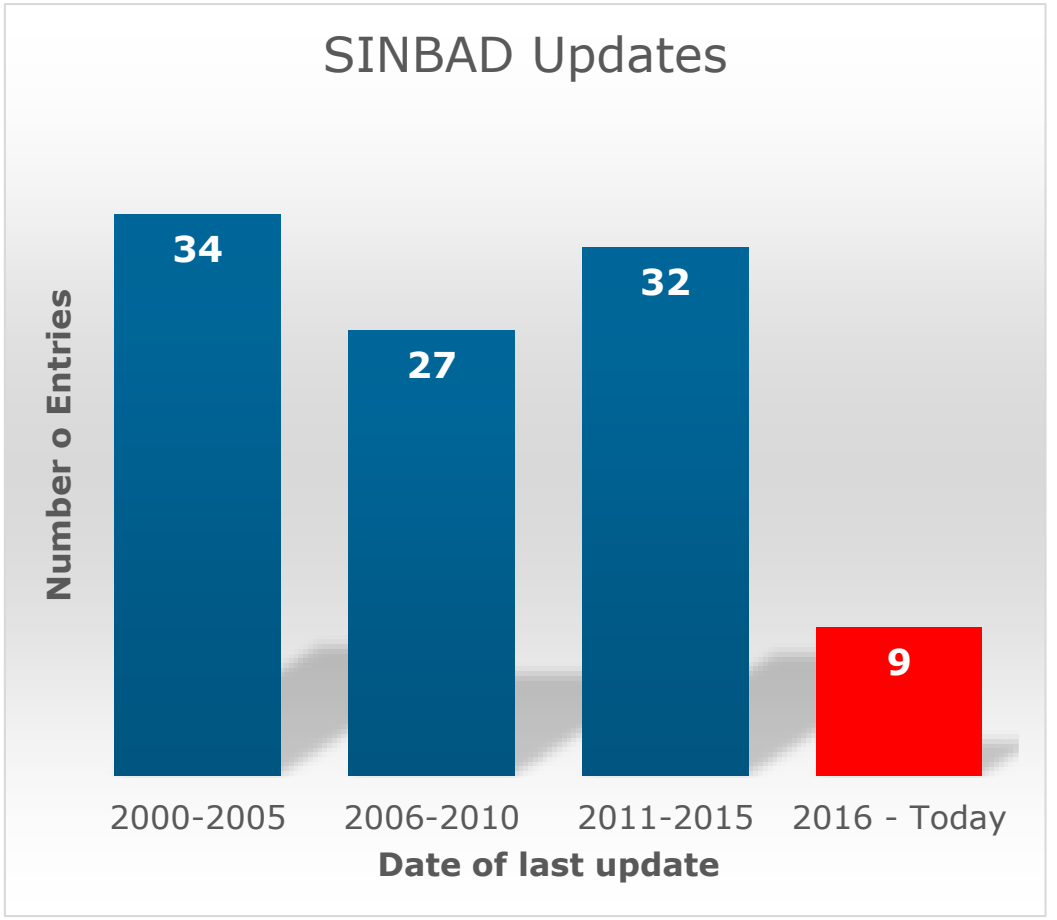
- **102 reactor, fusion neutronics, and accelerator shielding experiments**
  - **BUT: only 9 updates since 2016 and only 4 new experiments added in the last 10 years**

➔ **Motivation to initiate NEW EGPRS Task Force on SINBAD**

- Reinvigorate SINBAD
- Modernize the database building upon previous work
- Implement new software tools for database maintenance based on new NEA Data Bank infrastructure
- (Re-)Build community of database developers
- Adopt standardized format agreed in 2019 for SINBAD

➔ Improve the quality of the existing database entries

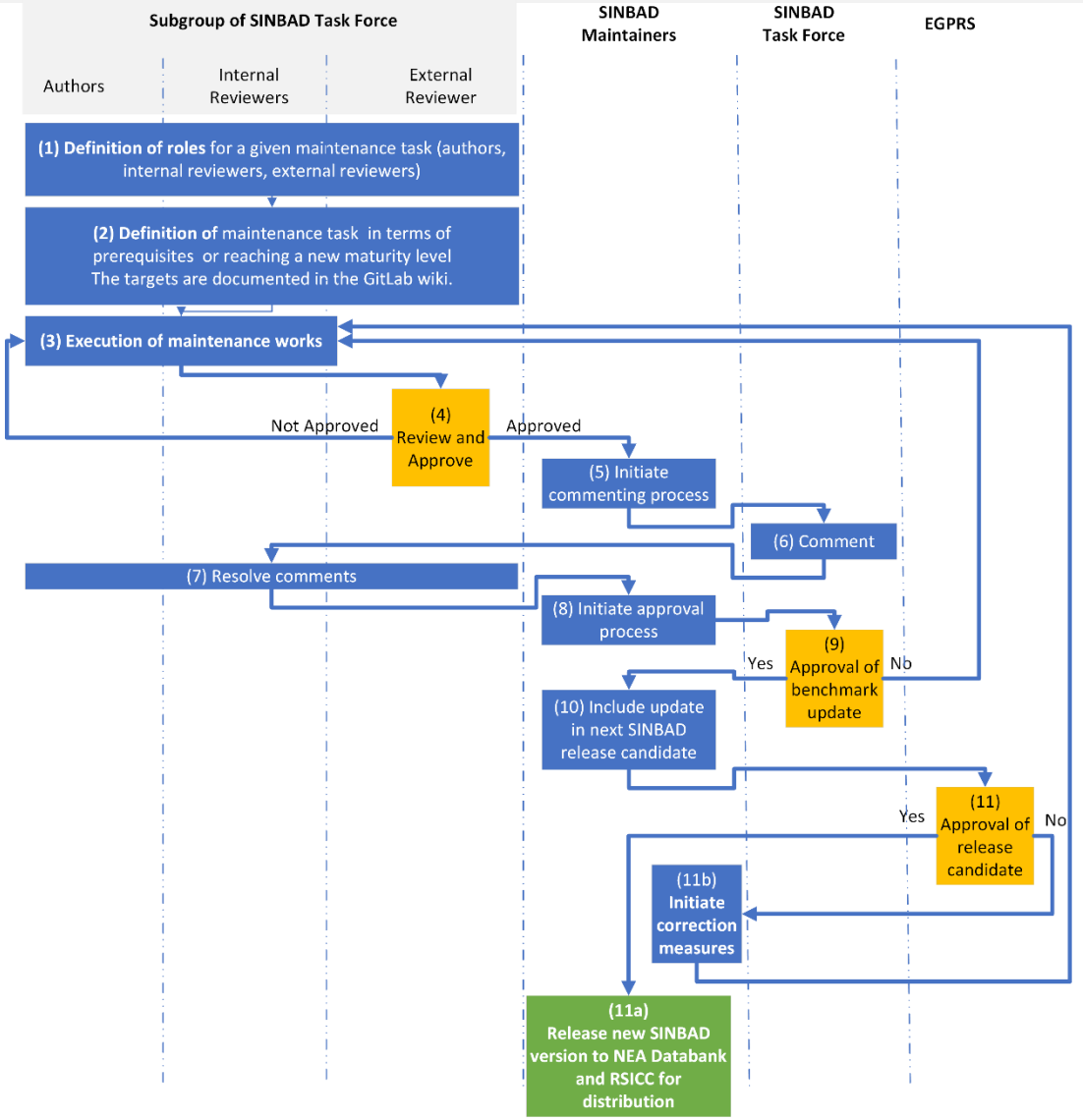
➔ Provide new database entries



New SINBAD Task Force

Chair: T. Miller (ORNL, USA)

- **Modular organization:** task force splits in several subgroups working on different entries/experiments
- **Progressive, well-defined process:** SINBAD entries can undergo subsequent updates to reach well-defined intermediate maturity levels with well-defined prerequisites
- Goal to update publicly available information automatically, as soon as a benchmark improvement has been approved
- **Process different to previous TRG guidance** of 2019 for the update process **and the process for ICSBEP**, which allows data of different quality to be included in SINBAD
- TRG template and guidance for drafting the evaluation as defined in ICSBEP TRG 2019 has been adopted for the new SINBAD Task Force
- **Participation**:
  10 NEA member countries + IAEA + CERN, 30 Institutions

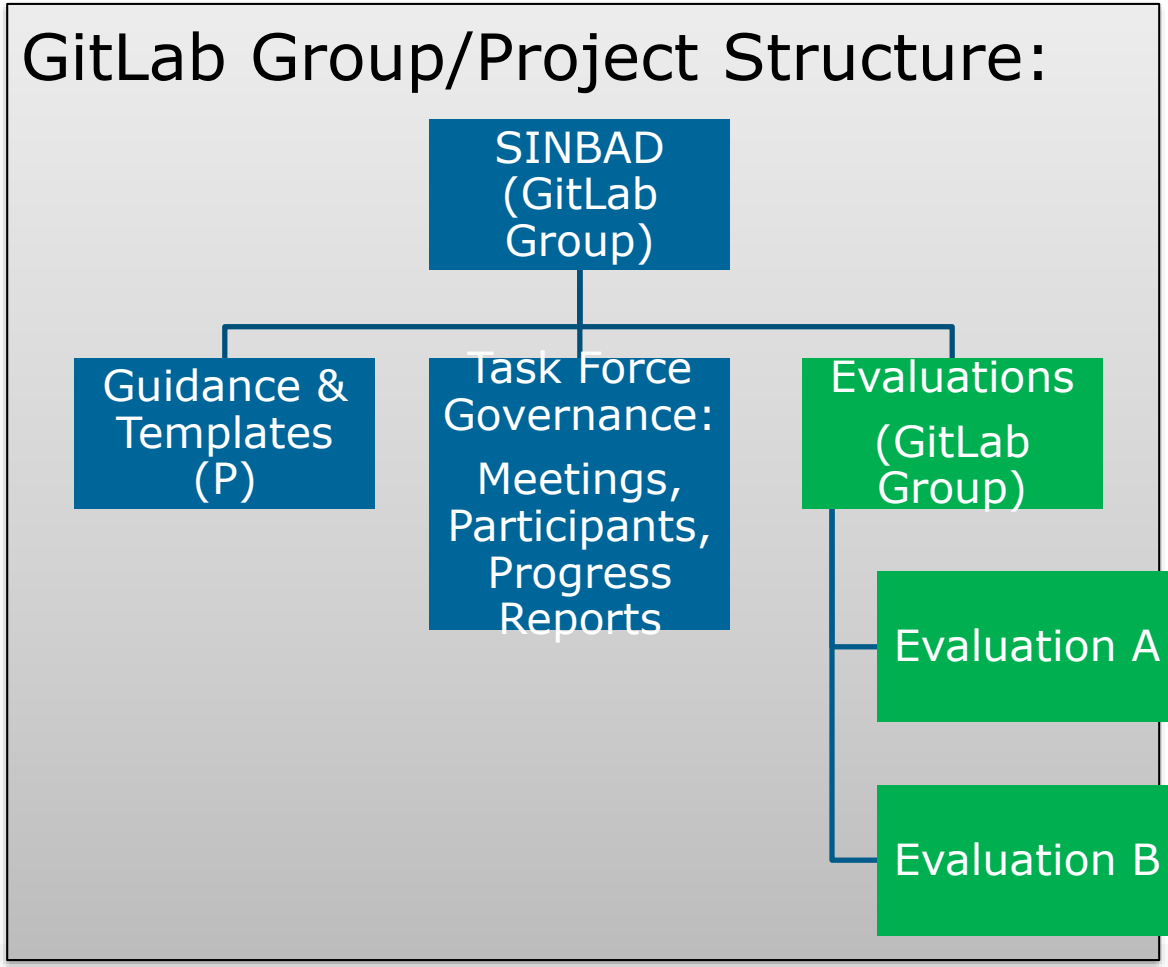


New SINBAD Maturity Level Scheme

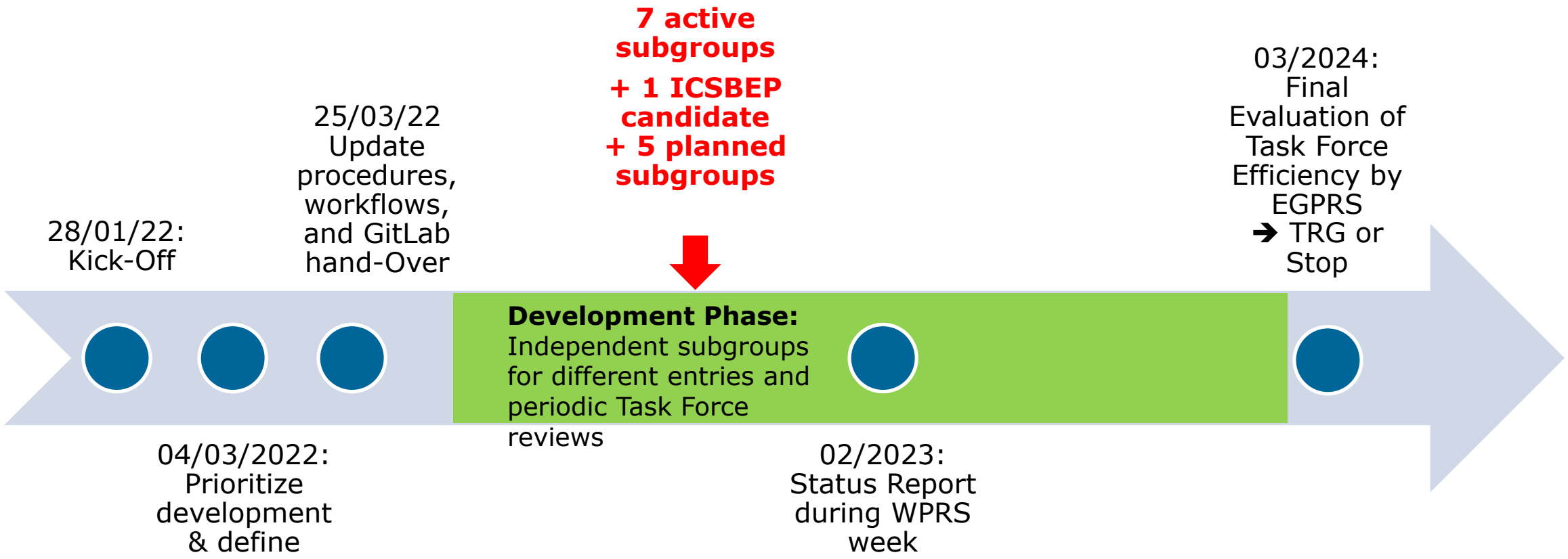
Prerequisites	Maturity Level				
	1	2	3	4	5
Re-distribution rights for experimental data and documentation has been obtained	☒				
Experiment documentation according to Section 1 of Evaluation Guide (SINBAD TRG, 2019[3])					
• Description of the measurement facility		☒			
• Description of each measurement configuration		☒			
• Description of materials		☒			
• Description of radiation sources		☒			
• Measurement of input and output variables		☒			
• Data in basic machine-readable format (e.g. CSV)		☒			
Evaluation of measurement data (Section 2 of Evaluation Guide (SINBAD TRG, 2019[3]))					
• Evaluation of measurement configuration			☒		
• Evaluation of radiation source			☒		
• Evaluation of the measured data			☒		
• Provision of computation models which have been used for evaluations			☒		
• Sensitivity and uncertainty analysis (including provision of computation models)				☒	
• Data in hierarchical machine readable data format (e.g. HDF5)					☒
Geometry as CAD model					☒
Benchmark model (Section 3 of Evaluation Guide (SINBAD TRG, 2019[3]))				☒	
Sample case results and input files for related computational models (Section 4 of Evaluation Guide (SINBAD TRG, 2019[3]))				☒	
Provision of automatic pre- & post-processing chain for the benchmark models					☒

New SINBAD development platform

- ***New* SINBAD development platform**:
  NEA GitLab hosted by OECD NEA Data Bank (on-premise)
  - GitLab access for task force and subgroup members
  - Subgroups work in branches & issue merge requests to maintainers (NEA & Task Force Chair)
- **Issue Tracking:**
  - Transparent issue tracking for development within GitLab
  - Users are asked to report issues to wprs@oecd-nea.org
- **SINBAD releases will be distributed by OECD NEA DB and ORNL/RSICC**



Status of SINBAD Task Force



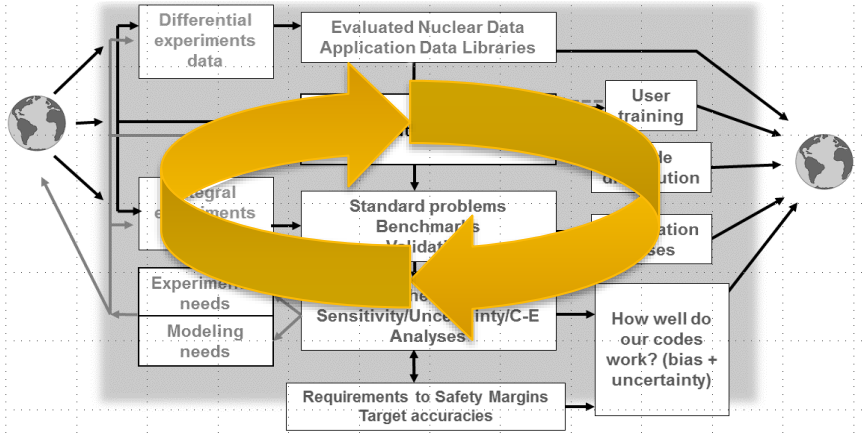
Active Subgroups

Subgroup Title	Coordinator	Application domain	Target Level	Due Date	Status
HIMAC	S. Tsuda (JPN)	**Accelerators:** secondary neutrons produced from thick targets bombarded by 100-800 MeV/nucleon ions beams	4 = ICSBEP	Feb-23	ICSBEP Candidate
Vessel fluence	A. Alpan (USA)	V&V for **RPV ageing studies**	1-2		In draft phase
LLNL pulsed spheres	S. Kim (USA)	**Fusion**: Attenuation of 14MeV neutrons on different materials	4-5	Feb-23	In external review
FNG Copper	I. Kodeli (UK)	**Fusion**: Attenuation of 14MeV neutrons in Cu	4	2023	In review process
KFK - n gamma	S. Simakov (GER), O. Buss (NEA)	Neutron and gamma attenuation in **Fe and the (n,gamma) reaction**	3-4	2023	In review process of Section 1
FNG HCLL	P . Ortego (SPN)	**Fusion: Tritium breeding** in a mockup of the European Test Blanket Module (TBM) based on lead-lithium and cooled by helium, the Helium Cooled Lead Lithium (HCLL) to be tested in ITER	4-5	2023	In review process
Broomstick: O 16	S. Simakov (GER), O. Buss (NEA)	**Attenuation of neutrons in O16**	3-4	2023	In review process of Section 1
CERF	R. Froeschl (CERN)	**Accelerators: Activation and residual dose rates + neutron shielding**, irradiation at CERN with hadron beam			In draft phase

  - **Oktavian**: 14 MeV neutron attenuation in Al, Fe, Ni, Si, W
  - **Water-cooled lithium lead (WCLL) breeding blankets**
- SFR
  - **SFR specific benchmarks**: JASPER-IHX, JANUS-1, JANUS-8, SB3-GAM, RA-SKYSHINE, SDT-12, EURACOS-NA (high interest by Terrapower)
- Dog-legged void neutron assembly **(DLVN): 3D neutron streaming**

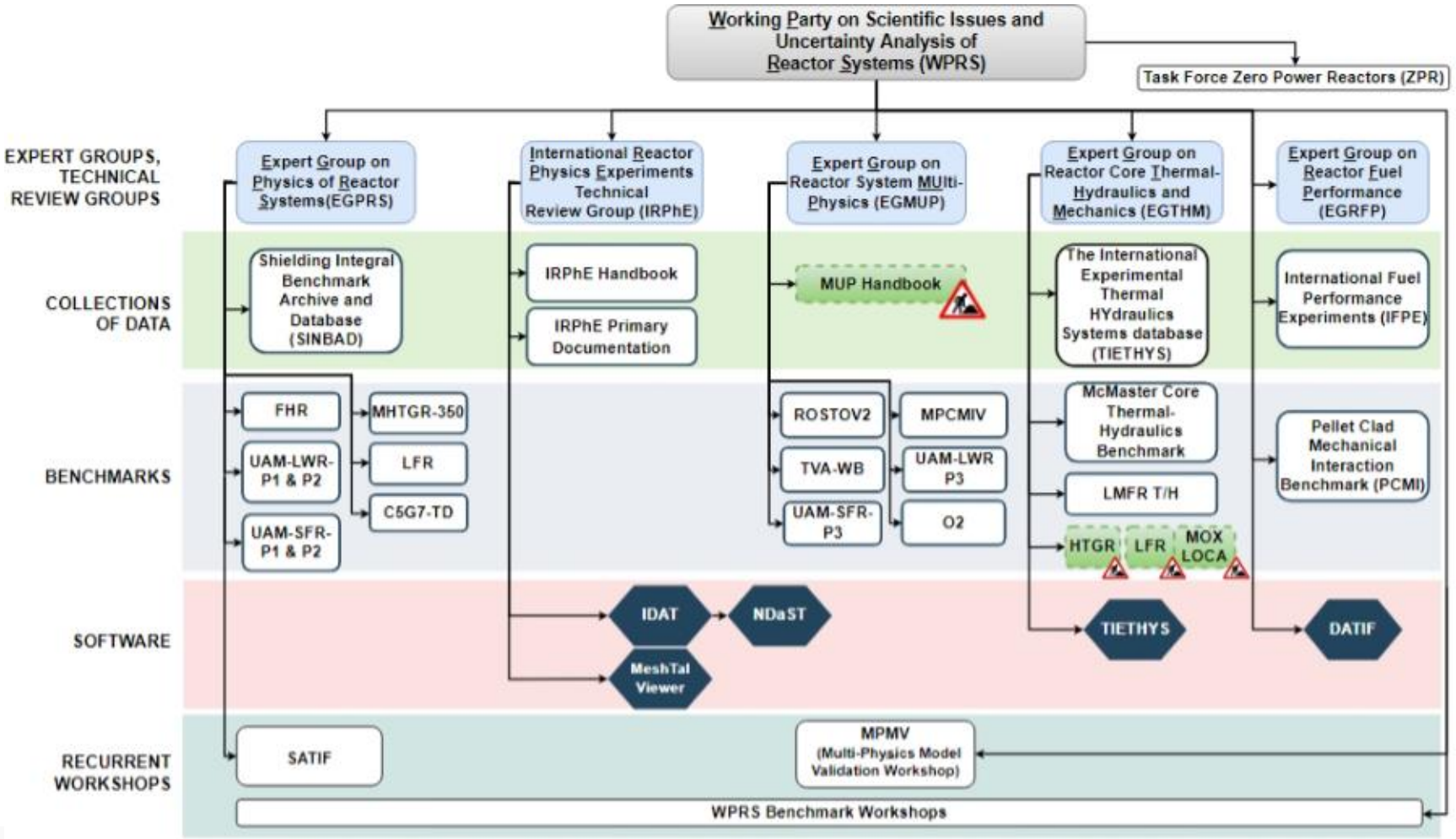
Generating Feedback

Limited Selection of Activities



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
- **>120** participants in 02/2022 meetings
- **17** ongoing benchmark phases, **3** planned benchmarks
- **172** benchmark participants to 2022 WPRS Workshops in Aix-en-Provence (30/05 -03/06 2022)
- Next meetings:
  20/02/23 – 24/02/23: WPRS Meeting, Paris
  22/05/23 – 26/05/23: WPRS Workshops, Bologna, Italy

http://oe.cd/wprs

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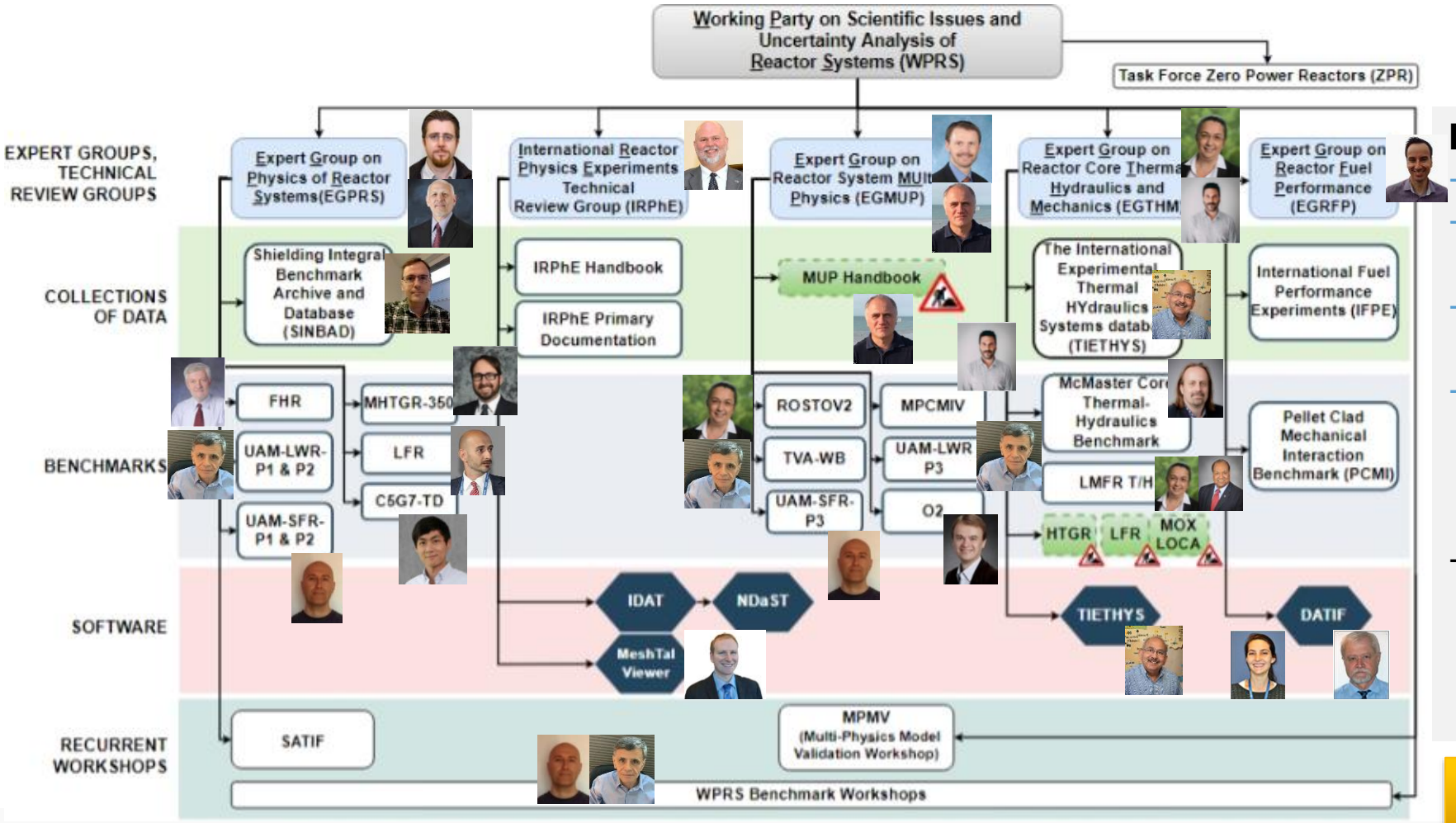

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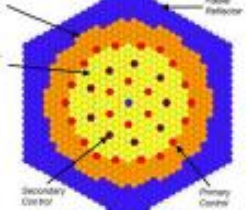
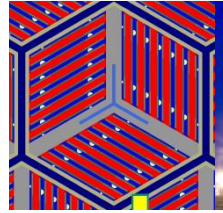
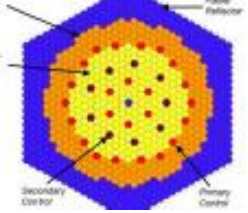
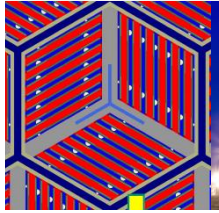
Reactor Single- and Multi-Physics Benchmarks: Current Activities


Ongoing Reactor Single- and Multi-Physics Benchmark Activities	System	Neutronics	T/H	Multi-Physics	Fuel Perf.	NDA?
Benchmark for Uncertainty Analysis in Best-Estimate Modelling for Design, Operation and Safety Analysis of • Light Water Reactors (LWR-UAM) • Sodium-cooled Fast Reactors (SFR-UAM)	LWR SFR	Focus on Uncertainty Quantification, wide range of LWR and SFR applications				No
Fluoride-salt-cooled High temperature Reactor (FHR)	MSR	Heterogeneities, TRISO				No
Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (C5G7-TD)	LWR	High fidelity to low fidelity information				No
TVA Watts Bar Unit 1 Multi-Physics Benchmark	PWR			Comparison to real reactor cycles & transients		No
Rostov-2 VVER-1000 Benchmark	VVER					**Yes**
Liquid Metal Fast Reactor Core Thermal-Hydraulics Benchmark (LMFR T/H)	LMFR		High fidelity simulations vs. experiment			No
McMaster Core Thermal-Hydraulics Benchmark	CANDU					No
Multi-physics Pellet Cladding Mechanical Interaction Validation (MPCMIV) Benchmark	PWR	High fidelity vs. low fidelity + comparison to experimental data				**Yes**
Lead Fast Reactor Benchmark	LFR	Fast flux & depletion				No
HTGR T/H based on measurements at HTTF Facility, Oregon State (USA)	HTGR		Simulations vs. Experiment			No

+ Several completed benchmarks distributed by NEA Data Bank (HTGR, PBMR, LWR, …) focusing on different physics aspects

Reactor Single- and Multi-Physics Benchmarks : Current Activities


Three major new initiatives:

1. Migration of all benchmark activities to SharePoint
   ➔ **Improved data exchange**
2.
3.

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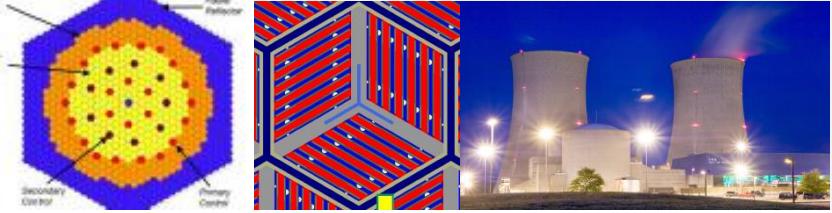

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   ➔ **Collect input decks and implement CI processes**

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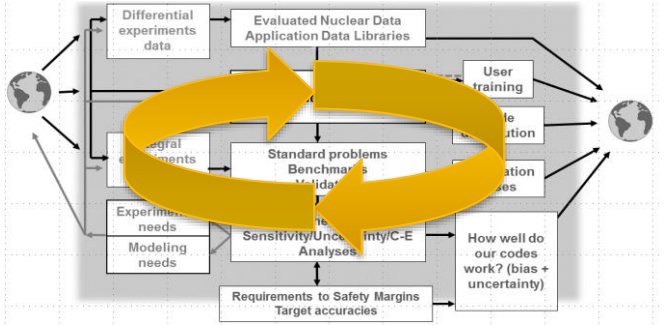

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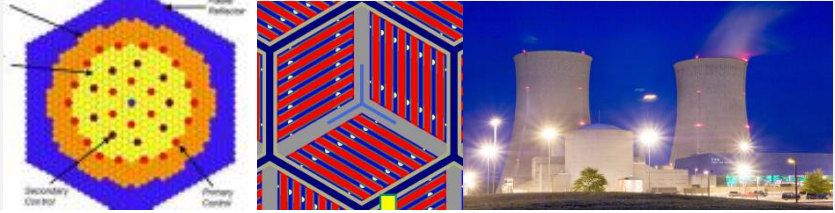

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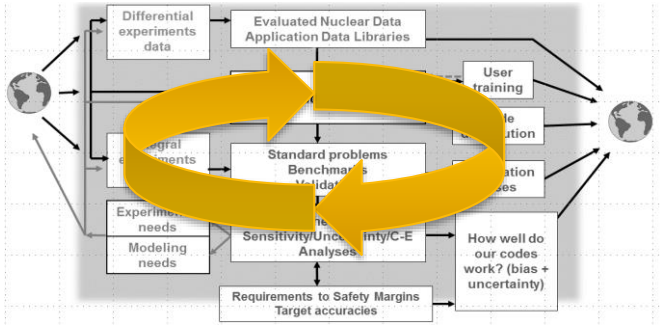
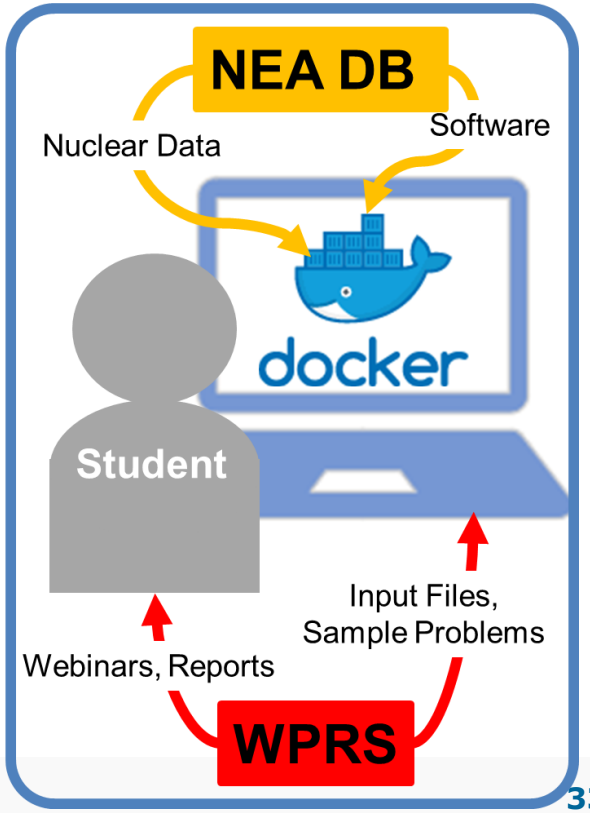
3. Prepare benchmarks as „**Student Training Sessions**", which can be used in class-room session or as remote classes on NEA LMS platform:

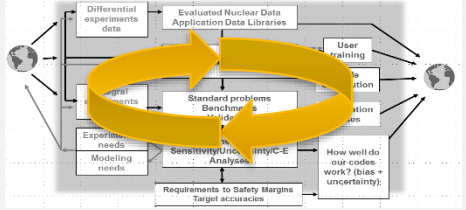
   - Existing specifications as basis for exercises
   - Exercises based on sample problems
   - Provide docker environments with all required tools by NEA DB (software tool chain must be open source or accessible via NEA DB);
   - Delivery Format: webinars and in-person trainings

   ➔ **Direct connection to NEA Global Forum's Working Group 2, TF3**





WPRS Zero Power Reactor (ZPR) Task Force



Status:
- Mandate accepted at WPRS 02/2022 meeting
- Kick-off in 09/2022

➔ Next: Stakeholder interviews

New Activity

cea

The demise of ZPRs – From concern to action

TF scope and mandate ← from proposal made to, and approved by, the NSC and WPRS

- Foster **joint actions & collaborations centred on the remaining facilities**, so that the situation (ZPRs *and* expertise) does not further deteriorate
- **Update the 2009 OECD/NSC report** in the form of a shorter document, specific to ZPRs (and criticality-safety facilities?), rather than as an update of the full original report
- Make **a stronger case for ZPRs**, to dispel some misunderstandings, justify the needs, and motivate restoring some experimental infrastructure → scientific motivation document, by a panel of international experts
- Consider actions to **increase awareness** at the decision-makers' level

"It was often a race between the theorists and the experimenters as to who could come up with a clue first, and experimenters usually won that race. Nature is a lot cleverer than we are, and if you can steal her secrets by observation, it's a lot quicker than trying to re-invent them."

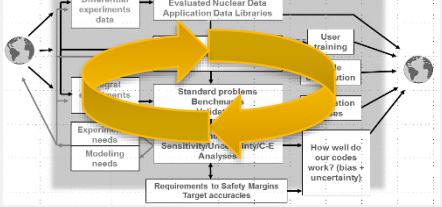
David Gross, Nobel Prize Laureate, 2004

Commissariat à l'énergie atomique et aux énergies alternatives | R. Jacqmin | February 25, 2022 | 3

Source: Presentation R. Jacqmin at WPRS 02/2022

Nuclear Data Sensitivity Tool (NDaST)

J. Dydra, I. Hill, N. Soppera



Benchmarks (Sensitivities) → Nuclear Data (% Change or Covariance) → Integral Results

- XML and GUI Input
- Database of over 4000 Sensitivity Data Files
- MF32/MF33
- Users can add MF31
- No MF34. Will come in the future.
- User defined covariance data
- Support added for MCNP6.2 created TSUNAMI3D format following JEFF 2021 winter meeting

Select / load benchmarks

sensitivities (S) & C/E data

DICE, IDAT

Personal Numerical Benchmarks

User Input Perturbation (P)

isotope/reaction/energy cross section

AND /OR

JANIS 4

Covariance data via JANIS (C)

Built in processed data for major libraries

Load personal (coverx)

M energy groups (fixed)

S*P

Δk_{eff} for selected cases

C/E output plot grouped by criteria

S*C*S^T

$U_{C(XS)}$ for selected cases

Additional uncertainty on output plot grouped by criteria

Matrix plot showing individual contribution to $U_{C(XS)}$ by isotope-reaction

JANIS MF33: ENDF/B-VII.1 = 2138 files, JEFF-3.2 = 5688 files JENDL-4.0 = 2155 files TENDL-2013 = 77811 files, SCALE6.2

www.oecd-nea.org/ndast

NDaST – GUI and Command Line

J. Dydra, I. Hill, N. Soppera

- **NDaST GUI tools** have been necessary to trouble shoot suspicious results. Linear perturbation theory, and the number of options depending on the exact code/library/benchmarks/covariance isn't a oiled machine.
- **NDaST command line**:

```
Usage: <input> <output> [OPTIONS]...
    <input>  : NDaST file with input parameters (sensitivities plus and/or
covariances)
    <output> : NDaST file with input parameters and calculation results
  Options:
    -q,  --quiet        : suppress all messages except errors
    -od, --off-diagonal : compute off-diagonal terms (cases/sensitivities
representativity, aka 'Ck')
    -f,  --force        : allow overwriting output file
```

  - Lots of potential for NDaST to integrate with other data sources, tools.
- NDaST API coming soon!
- Look for more training resources in 2022
- **Contact: Ian Hill** (ndast@oecd-nea.org)

www.oecd-nea.org/ndast

EPJ Nuclear Sci. Technol. 4, 14 (2018)

https://doi.org/10.1051/epjn/2018016

EPJ Nuclear Sciences & Technologies

Available online at:
https://www.epj-n.org

REGULAR ARTICLE OPEN ACCESS

A comparison of uncertainty propagation techniques using NDaST: full, half or zero Monte Carlo?

James Dyrda, Ian Hill, Luca Fiorito, Oscar Cabellos, and Nicolas Soppera*

OECD Nuclear Energy Agency, Boulogne-Billancourt, France

Received: 23 October 2017 / Received in final form: 18 January 2018 / Accepted: 4 May 2018

Updates @ NEA DB

NEA Data Bank - Work Areas

The Data Bank is a 'Centre of Reference' for computer codes, nuclear data and knowledge preservation – with MBDAV overseeing the delivery of outputs.

Intermediate Output Results (IORs) are **services** benefiting the Data Bank member countries:

1. **Computer Program Services (CPS)**: Acquisition, licensing, testing and distribution of computer codes, and organisation of training courses.

2. **Nuclear Data Services (NDS)**: Compilation of measured nuclear reaction data (EXFOR), co-ordination of the Joint Evaluated Fission and Fusion (JEFF) project and related tool development.

3. **Databases of Experiments and Nuclear Knowledge Management**: Preservation and distribution of data (including NEA joint projects and benchmarks) and support for training and educational activities.

NEA Data Bank - Updates on Technology

1. **New GitLab instance with on-site Harbor, Docker and NEA CI cluster** and launched in March 2022 that supports CPS and NDS activities. This is a long-term solution following pilot projects with limited functionality.

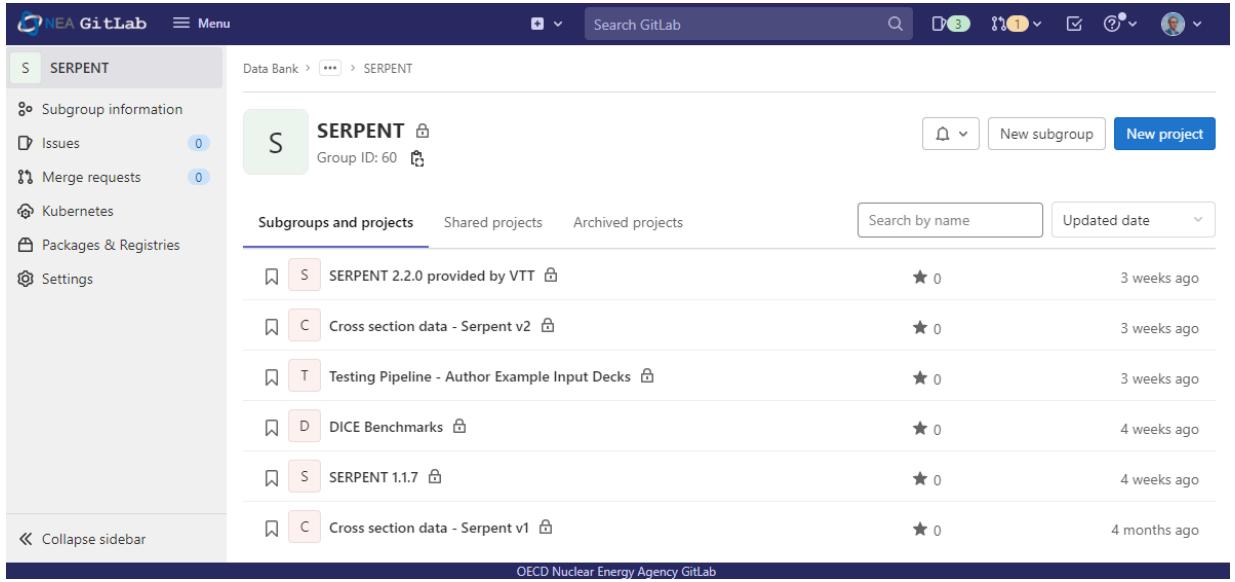
2. **New Canvas LMS (eLearning)** launched in April 2022 with first course pilot on the open source OpenMC code. A new blockchain-based credentialing system with social media integration is in progress **(Accredible).**

3. **SharePoint MyNEA** to replace oecd-nea.org/download was launched in May 2022 (where MBDAV content is now stored). This will be used for official meetings for JEFF and other DB restricted file content management.

4. **More in progress** including a public SharePoint system for machine-readable data storage (coming Q4 2022) and static-site-generated content for advertisement of NEA GitLab and associated system content.

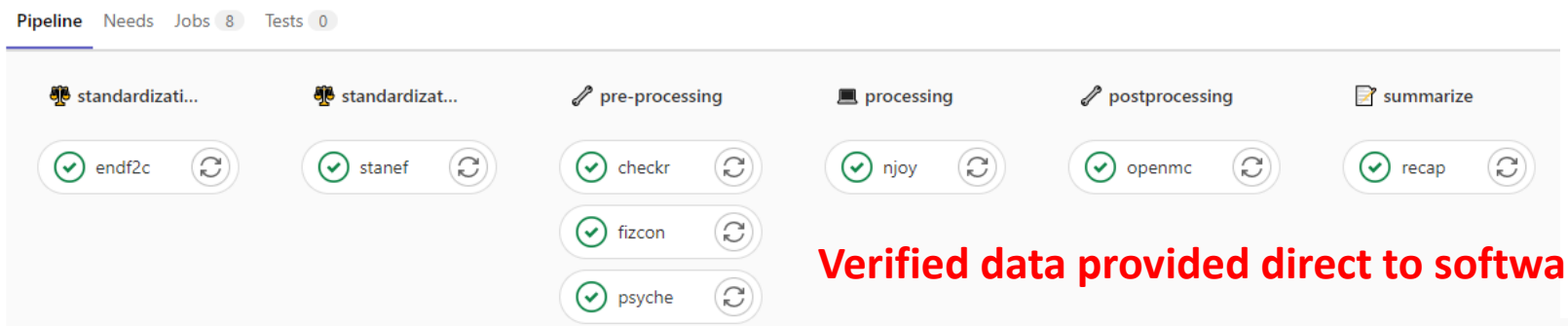
NEA Data Bank - CPS new working methods

- Direct engagement with developers through the NEA GitLab **NOT** to 'only' use the GitLab platform as a repository service, but to leverage several other services:
  - Move CPS quality checks into a transparent, collaborative and reproducible system
  - Containerise code for use in other NEA pipelines (e.g. data processing, benchmarks)
  - Create portable images with code (and/or other content) for a range of user needs, including education and training activities
- Example – release in May 2022 of Serpent-2 (VTT, Finland) Monte-Carlo code
  - Cutting-edge nuclear data and benchmarks directly integrated into overall package



JEFF nuclear data

- JEFF collaboration is developing a cutting-edge 4.0 library for general-purpose applications
- Adoption of GitLab-based workflows to manage the project, test the data in real time and directly integrate it with computer codes of DB, processing and validation with suites of NEA benchmarks
- Now releasing automatic SCALE, SERPENT-2, FISPACT-II and other data libraries in a variety of formats (including GNDS) https://www.oecd-nea.org/dbdata/jeff/jeff40/t1/
- 'T2' library planned announcement November 2022



Verified data provided direct to software partners

Conclusions

- **Integral benchmark activities for radiation transport under the auspices of the NEA Nuclear Science Committee**
  - ICSBEP, IRPhE, SINBAD, SFCOMPO under continuous development
  - New maintenance process for SINBAD
  - Reactor Single- and Multi-Physics Benchmarks: potential for improved feedback to code developers and education outreach
- **Nuclear Data Sensitivity Tool (NDaST)**
  - Continue development of tools that give rapid or continuous performance assessments of new nuclear data libraries (months ➔ minutes)
  - Incorporate legacy experiments (and proprietary data)
  - Time to integrate more application cases in testing!
- **Updates at NEA DB**
  - New technologies to implement continuous testing: GitLab, Docker, Harbor
  - JEFF nuclear data: test the data in real time

➔ **Looking forward to discussing cooperation in CoNDERC project**

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Ideas for common efforts:

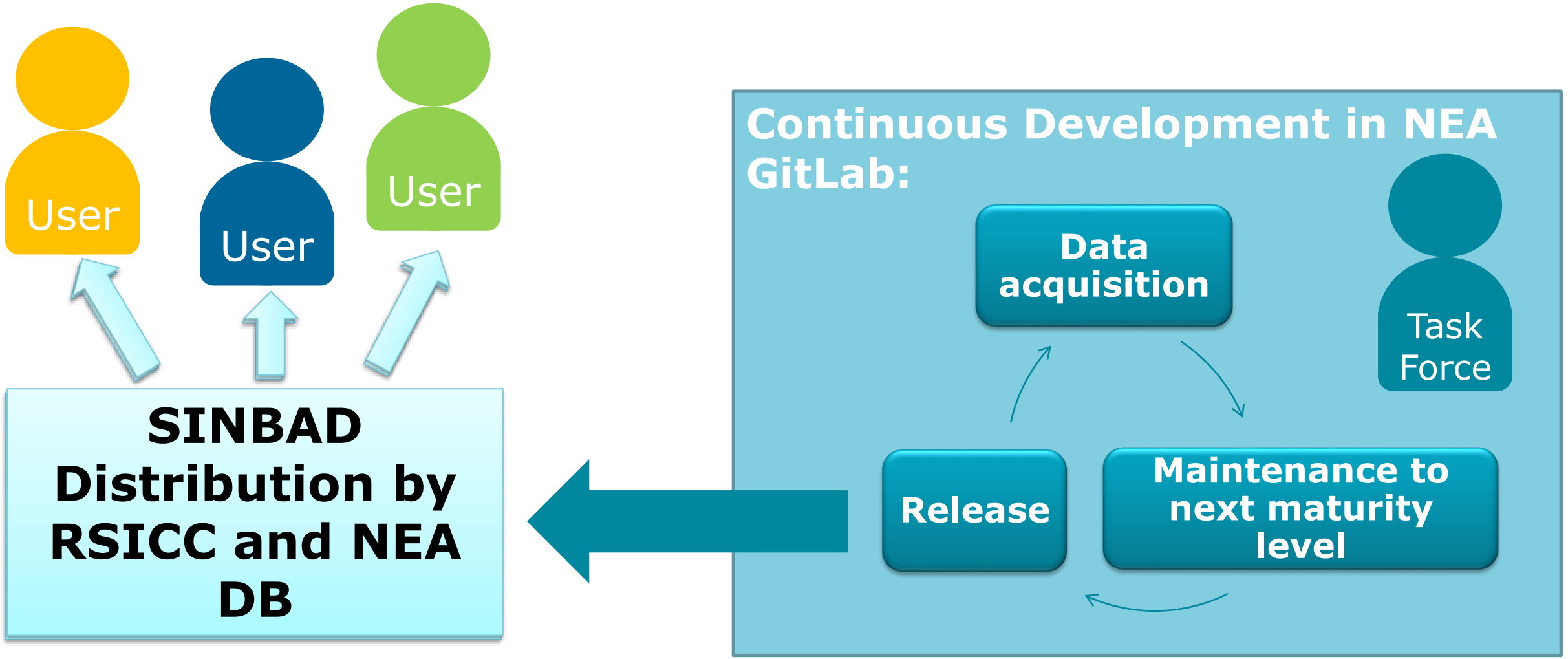
1. Benchmark gap analyses and new evaluations
2. **Tool chains** for data processing and continuous testing (CT)
3. **Consolidate test cases**
   - ❑ Additional **sensitivities**
   - ❑ **Correlations** (essential for ML/AI)
   - ❑ Pre-/Post-Proc for **CT**
   - ❑ **Prioritization**
4. Best practise CT/hosting
5. Participation in NEA bodies

Thank you for your attention

Please contact wprs@oecd-nea.org if you have questions related to this presentation.

Backup

SINBAD: Iterative Maintenance and Releases



WPRS - Benchmarks for Education

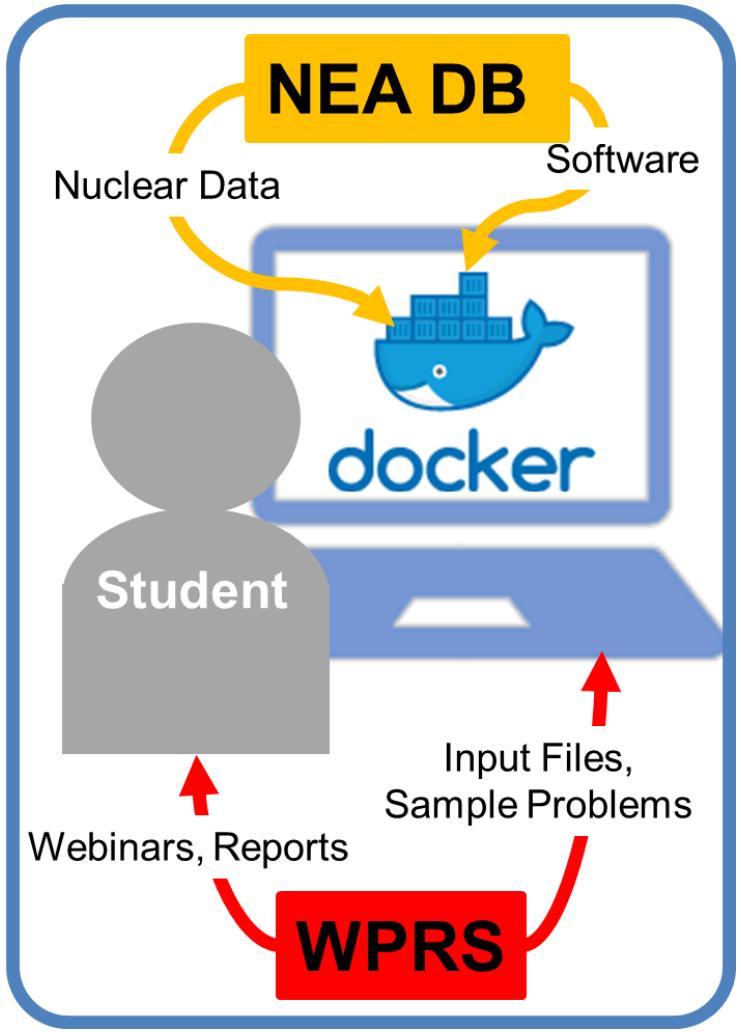
New Activity

- **WPRS produced comprehensive sets of benchmarks**: Reactor Physics, Thermal-Hydraulics, Multiphysics, Shielding (SINBAD)

- **Prepare benchmarks as „Student Training Sessions**", which can be used in class-room session or as remote classes on NEA LMS platform:
  - **Existing specifications as basis for exercises;**
  - **Exercises based on sample problems**:
    - Input deck sets provided by benchmark participants which include „Holes", i.e. need to be adjusted/adapted;
    - Results need to be extracted/interpreted by students.
  - **Provide docker environments** with all required tools **by NEA DB** (software tool chain must be open source or accessible via NEA DB);
  - **Include supplemental lectures on reactor technologies;**
  - **Final session with student presentations and expert attendance.**

Delivery Format: webinars supported by NEA LMS platform

➔ **Direct connection to NEA Global Forum's Working Group 2, TF3**



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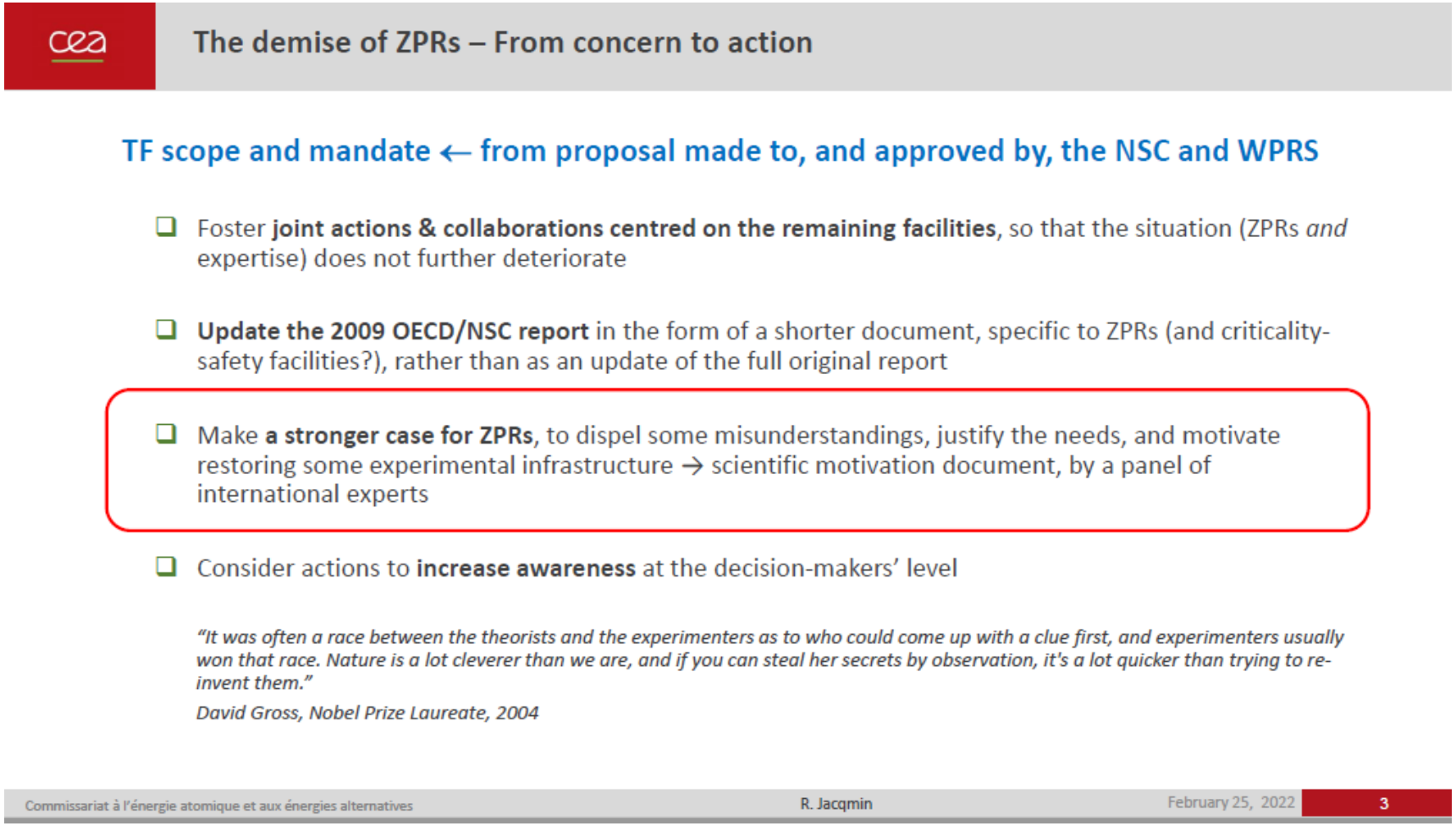

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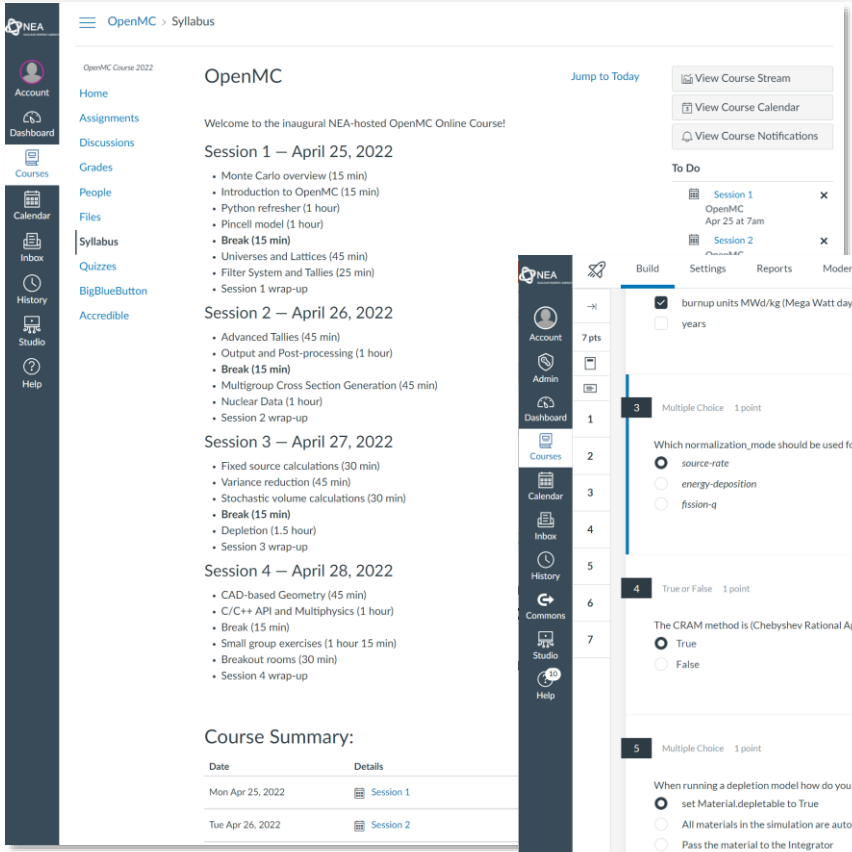
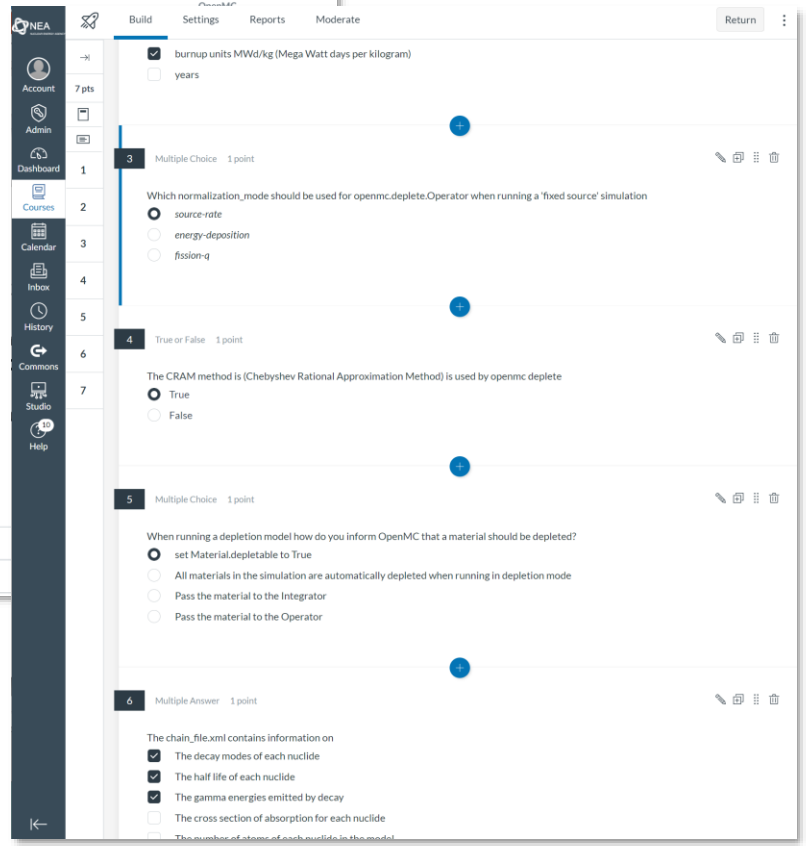
DB eLearning

- Easy implementation even with short time frame (tool available less than two weeks before the course)
- Course naturally defined with module and syllabus tools to structure content
- The course took place on Zoom and all course content was accessed through Canvas
- Assignments and reviews conducted in the system significantly increased engagement
- Positive feedback from participants and teachers – pilot OpenMC will be repeated in October 2022! FISPACT, PHITS, SCALE, IRPS, and more already in 2022 with more to come





Credential System

- Accredible credential system will issue digital badges
- Badges sharable e.g. with LinkedIn with blockchain verification
- NEA catalogue of courses and certificates
- Links to course, NEA and provider (if requested) to provide cachet, marketing and publicity
- Describing outcomes and exercises increases value
- Assignments and pass/fail integrated into Canvas before issuing credentials
- Launched in June 2022