

# NEA Nuclear Data Activities

**Michael FLEMING**

**Head of the Data Bank (Acting)**

*33<sup>rd</sup> Meeting of the International Nuclear Data Committee (INDC)  
29 March - 1 April 2021*

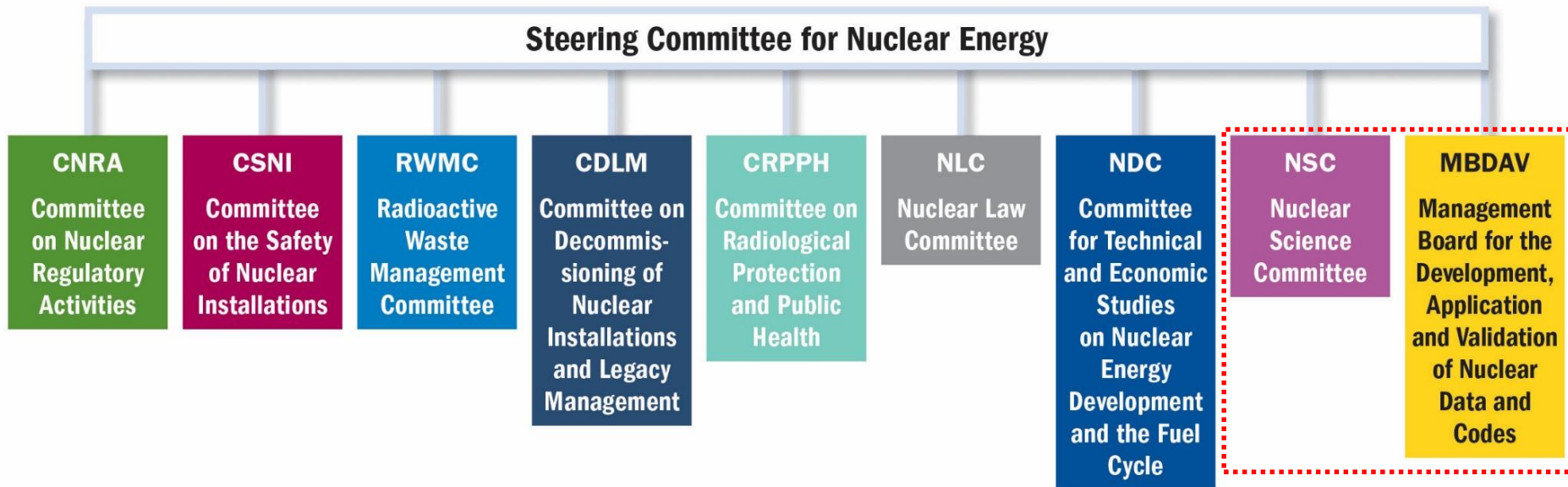
## The NEA: 34 Countries Seeking Excellence in Nuclear Safety, Technology, and Policy

- 34 member countries + strategic partners (e.g. China and India)
- 8 standing committees and more than 70 working parties and expert groups
- The NEA Data Bank - providing nuclear data, code, and validation services
- Global relationships with industry and universities.



**NEA countries operate about 90% of the world's installed nuclear capacity**

## NEA Structure



## JEFF (DB), EXFOR (DB) and WPEC (NSC)

## IAEA Collaboration

- NEA and IAEA have long and deep history of collaboration and co-ordination to maximise impact on international nuclear data activities
- IAEA Nuclear Data Section engagement has been a key ingredient to the success of the NEA nuclear data programme of work
- NEA and IAEA organisational instruments (e.g. CRPs, SGs) are complementary and offer options for the community in launching collaborations
- IAEA Staff on Loan within Data Bank provides distribution services to non-OECD IAEA members

## JEFF Nuclear Data Library Project

- Long-standing project with original JEF-1 release in 1986, outputs are in use across the world for nuclear energy, science, technology and other applications
- Development and testing of a general-purpose nuclear data library, including neutron and other incident particle data, decay data and fission yields
- Multiple sub-groups operating on long-term or ad hoc basis to address aspects of the JEFF development process
- 2 'Nuclear Data Weeks' per year in April/November – now hosted online – next meeting is **26-30 April 2021**



Chair of JEFF

Dr Arjan PLOMPEN

JRC-Geel, EC

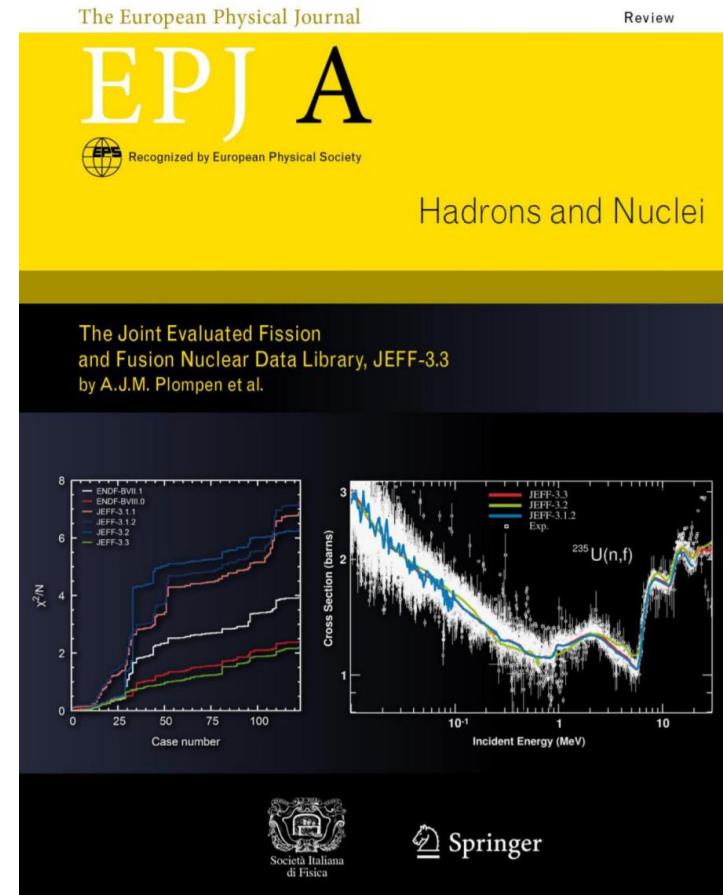
## JEFF Nuclear Data Library Project

- Latest release JEFF-3.3 publication in EPJ/A 2020

*A. Plompen et al., The Joint Evaluated Fission and Fusion Nuclear Data Library, JEFF-3.3*

<https://doi.org/10.1140/epja/s10050-020-00141-9>

- Over 70 co-authors from 30 organisations including the IAEA Nuclear Data Section
- Leverages IAEA project outputs including the Neutron Standards and contributions from IAEA to other projects including CIELO

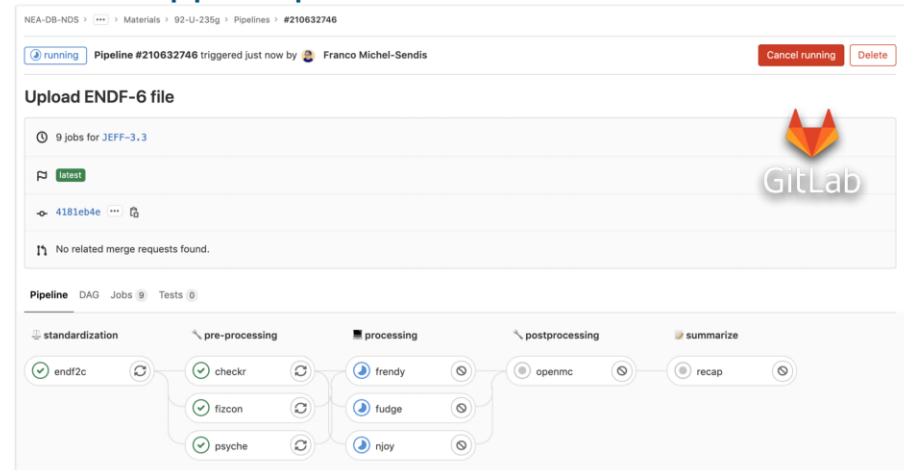


## GitLab at the NEA

- In 2018 the NEA implemented a GitLab system with core functionality that has been used for projects such as EXFOR compilation and the GNDS specifications
- The implementation of an upgraded service has been in planning since 2019, providing more computational resource in runners, full docker container registries, 'gitlab-pages' and other features
- Since Feb/March 2021 NEA is now rolling out a new GitLab instance with more sophisticated architecture to accommodate these functionalities – **expected migration in Q2 2021**
- **This will be a key platform for current and future cross-DB and cross-NEA work**

## GitLab for JEFF

- This system offers a powerful collaboration tool with built-in, automated processes including processing, testing and benchmarking
- Replaces/integrates previous scripts and processes such as NDEC
- PoC developed using cloud-based solutions and will be migrated (with first NEA instance) in 2021



The screenshot shows a GitLab pipeline named 'Upload ENDF-6 file' in a 'running' state. It was triggered by Franco Michel-Sendis. The pipeline consists of several stages: 'standardization' (with job 'endf2c'), 'pre-processing' (with jobs 'checkr', 'fizcon', and 'psyche'), 'processing' (with jobs 'frendy', 'fudge', and 'njoy'), 'postprocessing' (with job 'openmc'), and 'summarize' (with job 'recap'). A GitLab logo is visible in the top right corner of the interface.

### Browse by isotope

F. Michel-Sendis, D. Foligno, 2020

Last updated : 2020-11-10 11:53:26

Show 600 entries

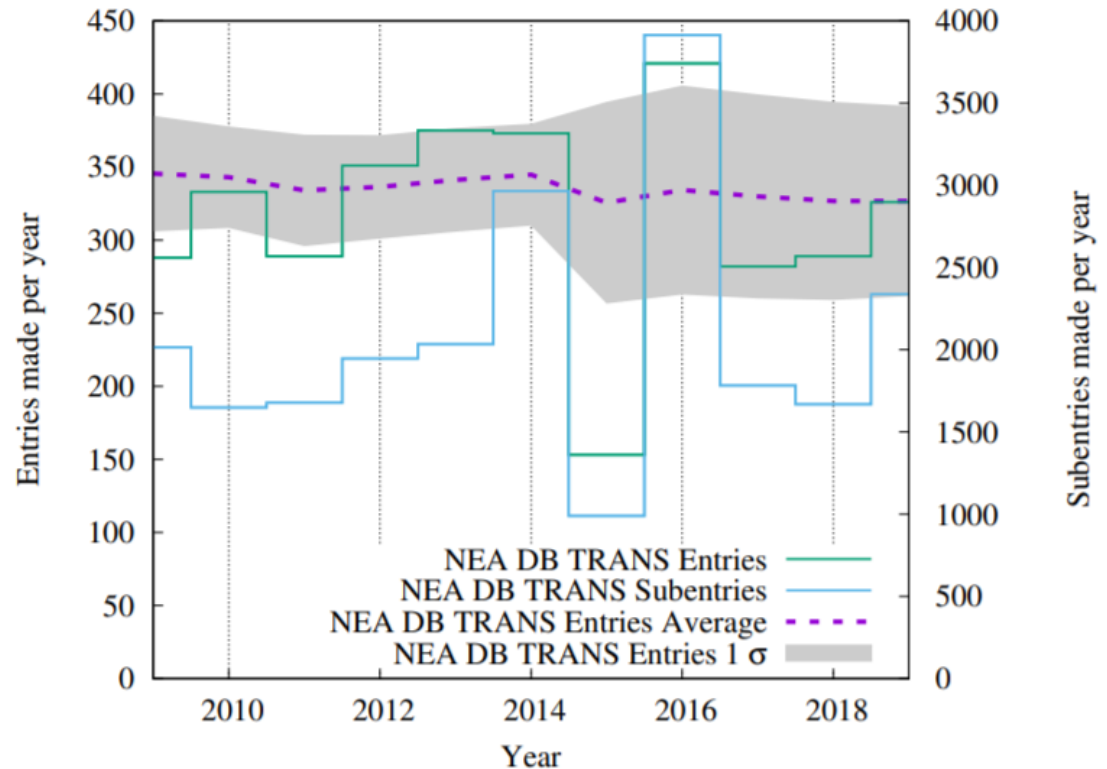
Showing 1 to 562 of 562 entries

Z	Isotope	Choice	ENDF2C	CHECKR	FIZCON	PSYCHE	NJOY	FRENDY	FUDGE	OPENMC	Download
1	H-1g	ENDF-B-VIII.0	0	0	1	0	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>
1	H-2g	JEFF-3.3.1	0	0	1	237	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>
1	H-3g	ENDF-B-VIII.0	0	0	0	0	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>
2	He-3g	JEFF-3.3	0	0	0	0	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>
2	He-4g	ENDF-B-VIII.0	0	0	0	0	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>
3	Li-6g	ENDF-B-VIII.0	0	0	1	0	0	0	0	0	<a href="#">ENDF-6</a> <a href="#">ACE</a> <a href="#">GNDS</a> <a href="#">HDFS</a>



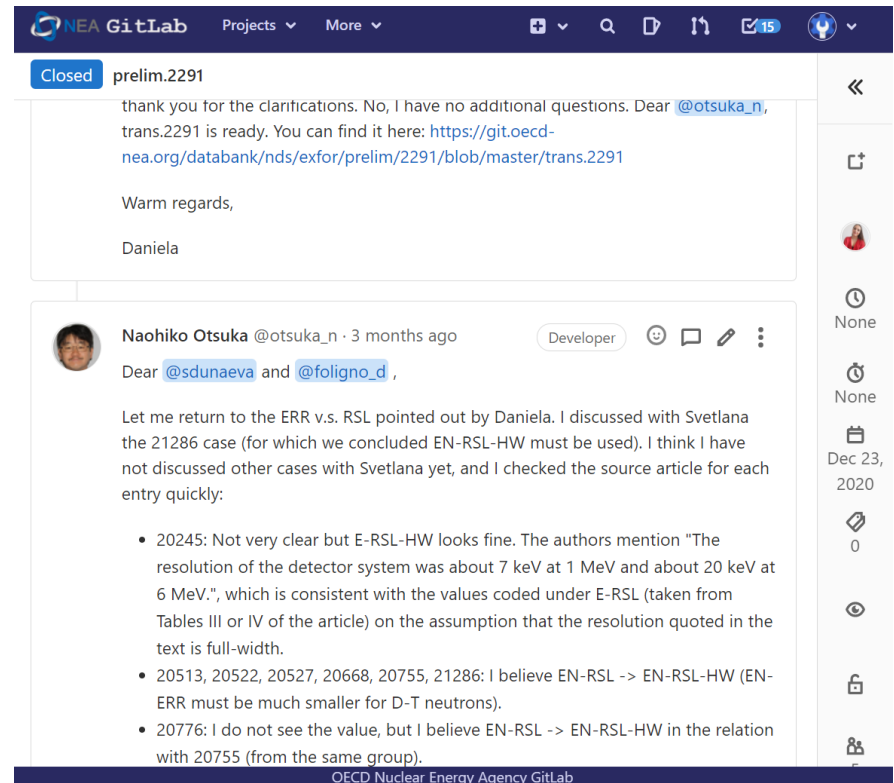
## EXFOR compilation

- As the areas 2 and O compiler centre, the NEA Data Bank continues to play a central role in the EXFOR project within the NRDC
- Approximately 300 new or revised entries per year
- **Strong collaboration with IAEA through NRDC**
- Ongoing work with SG50 to develop proposals for enhancements to meet needs of user community



## GitLab for EXFOR

- NEA EXFOR compilation work migrated to GitLab in 2018
- Processes are now increasingly captured within the system including preservation of entry development and QA
- Automatic communication to all NRDC and several computer processes remain manual



The screenshot shows a GitLab issue titled "prelim.2291" with a "Closed" status. The issue is a discussion thread. The first message is from Daniela, thanking Naohiko Otsuka for clarifications and providing a link to the GitLab blob for the entry. The second message is from Naohiko Otsuka, replying to Daniela and @sdunaeva, discussing the 21286 case and providing a list of three entries (20245, 20513, 20522, 20527, 20668, 20755, 21286) with their respective EN-RSL and EN-RSL-HW values. The interface includes a top navigation bar with "NEA GitLab", "Projects", and "More" menus, and a right sidebar with navigation icons.

NEA GitLab Projects More

Closed prelim.2291

thank you for the clarifications. No, I have no additional questions. Dear @otsuka\_n, trans.2291 is ready. You can find it here: <https://git.oecd-nea.org/databank/nds/exfor/prelim/2291/blob/master/trans.2291>

Warm regards,  
Daniela

Naohiko Otsuka @otsuka\_n · 3 months ago Developer

Dear @sdunaeva and @foligno\_d ,

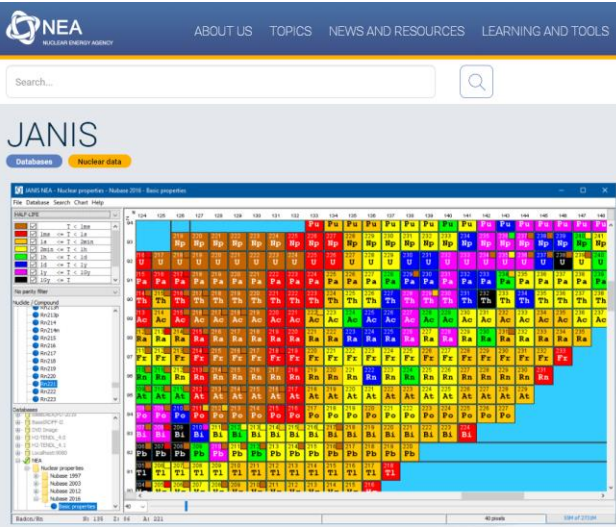
Let me return to the ERR v.s. RSL pointed out by Daniela. I discussed with Svetlana the 21286 case (for which we concluded EN-RSL-HW must be used). I think I have not discussed other cases with Svetlana yet, and I checked the source article for each entry quickly:

- 20245: Not very clear but E-RSL-HW looks fine. The authors mention "The resolution of the detector system was about 7 keV at 1 MeV and about 20 keV at 6 MeV.", which is consistent with the values coded under E-RSL (taken from Tables III or IV of the article) on the assumption that the resolution quoted in the text is full-width.
- 20513, 20522, 20527, 20668, 20755, 21286: I believe EN-RSL -> EN-RSL-HW (EN-ERR must be much smaller for D-T neutrons).
- 20776: I do not see the value, but I believe EN-RSL -> EN-RSL-HW in the relation with 20755 (from the same group).

OECD Nuclear Energy Agency GitLab

## JANIS new release

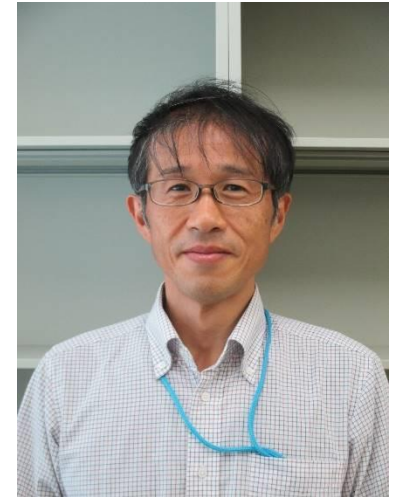
- **JANIS version 4.1 was released in September 2020 (first release since 4.0 in 2013)**
- Includes updates to webstart version, books, application, libraries, supported data, much more
- Wide range of features are documented in the 'What's new in 4.1' page
- Existing CLIs for JANIS and other related tools (e.g. DICE, NDAST) for script/automated tasks – although documentation is limited
- DICE API planned for 2021



The screenshot shows the JANIS web interface. At the top, there is a search bar and navigation links for 'ABOUT US', 'TOPICS', 'NEWS AND RESOURCES', and 'LEARNING AND TOOLS'. Below the search bar, the 'JANIS' title is displayed, followed by a 'Databases' section with a 'Nuclear data' tab selected. The main content area features a periodic table where each element's cell contains a small icon or data point, color-coded by group. On the left side, there are several panels: 'NUCLEI', 'Isotopes', 'Nuclei properties', and 'Nuclear properties', each with a list of items and their corresponding symbols. Below the periodic table, there is a 'JANIS screenshot' section with links for 'What is JANIS?', 'Screenshots', 'What's new in 4.1 (Sept 2020)', 'Content of the NEA database', and 'Help pages'. At the bottom, there are four main navigation buttons: 'Launch JANIS 4.1' (Java Web Start), 'Downloads' (Software, Manual, DVD 4.0 ISO), 'JANIS Web' (Online version, no Java required), and 'JANIS Books' (Experimental and evaluated cross-sections). A yellow box highlights recent updates: 'TENDL-2019, IRDFF-II, JENDL/PD-2016.1, CENDL-3.2 and IAEA/PD-2019 have been recently added to the NEA database', 'JANIS Books have been updated with the latest libraries', and 'JANIS Web has a new design and now provides resonances and decay lines searches, and a new covariance matrices search'. A 'Feedback' section at the bottom provides contact information for Nicolas Soppera (janisinfo@oecd-nea.org) and mentions an archive of messages at www.oecd-nea.org/lists/janis.html.

## WPEC admin

- 50 subgroups have been created over 31 years with 8 active (2 closed in 2020)
- 2 Expert Groups have been established to address long-term high-priority needs and an international standard data format
- 32<sup>nd</sup> WPEC meeting and subgroups was held 11-15 May 2020 (via WebEx) with a **record 130 participants** in 10 sessions
- 9-16 November 2020 meetings held with **114 participants** and 7 December SG47 with **41**
- **33<sup>rd</sup> WPEC to be held 10-14 May 2021**
- **Tentative first hybrid meeting 6-10 December 2021 (conditions permitting)**



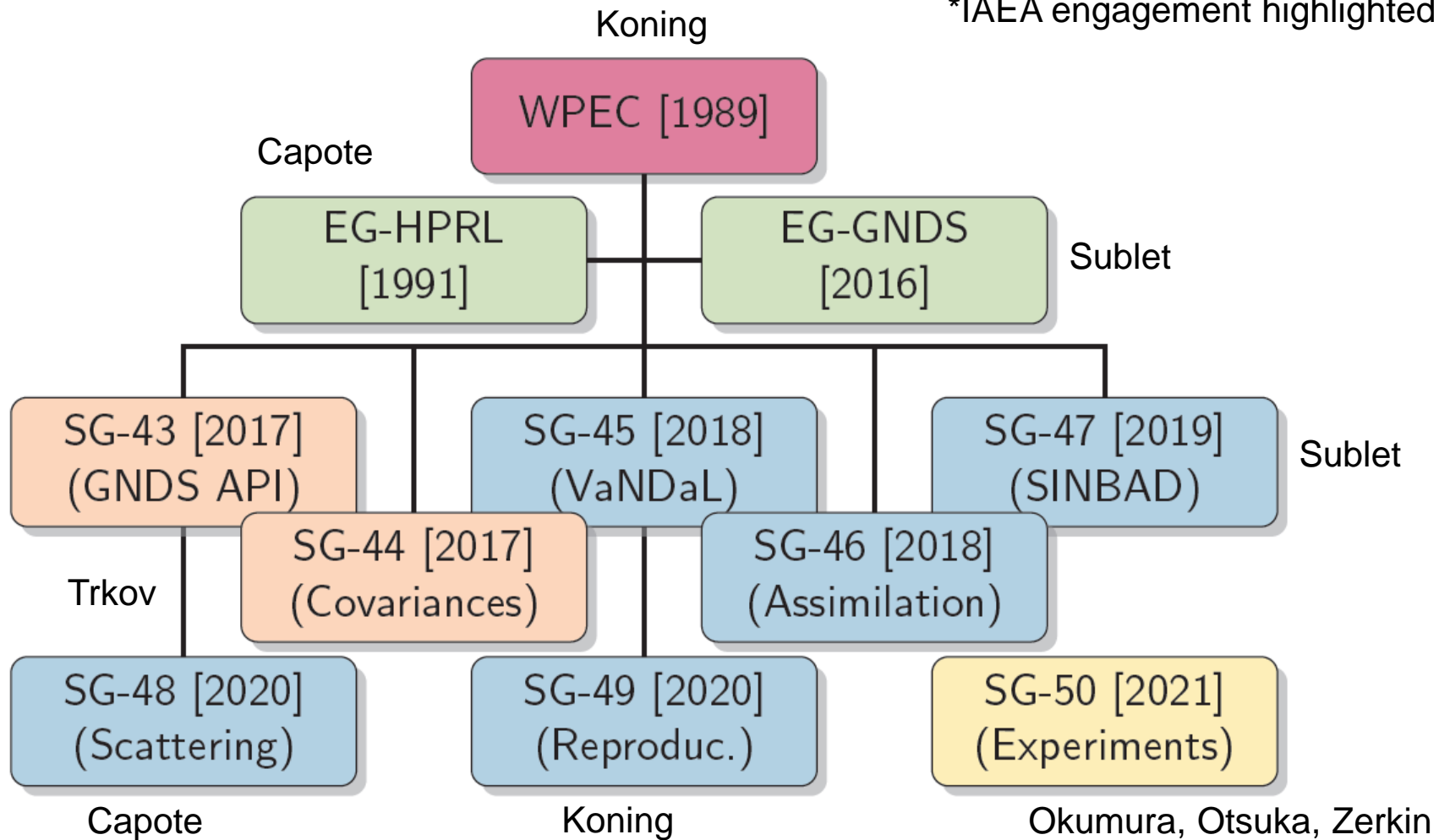
Chair of WPEC 2019-2021

Dr Osamu IWAMOTO

Head of the Japanese Nuclear Data Center, JAEA

## WPEC (NSC) overview

\*IAEA engagement highlighted



## EG on High Priority Request List

**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 with modern nuclear data libraries
  - Continuously updated/reviewed with progress and new requests
- HPRL provides reviewed data that funding decision-takers need to determine what research to support
  - SG41 and SG40/CIELO were direct responses to needs expressed through the HPRL
- A new HPRL system (in JCMS) is in development with the new NEA website and will be made public in 2021
  - **Active NEA development period ongoing Q1/Q2 2021**



EG-HPRL Chair

Dr Emmeric DUPONT

CEA, France

## EG on Generalised Nuclear Data Structure

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

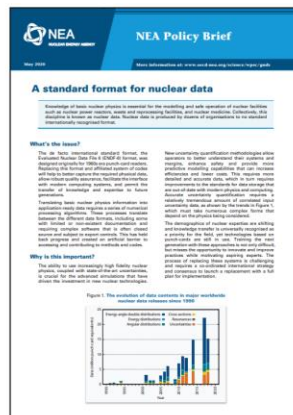
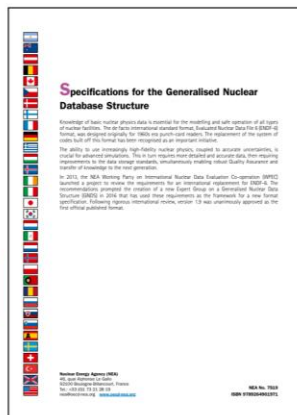
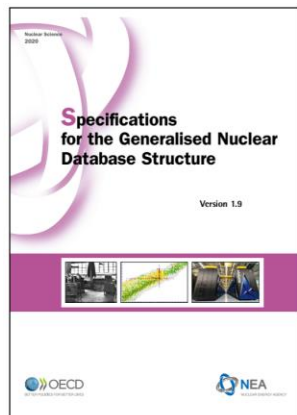
- Nuclear data has been stored in the ENDF-6 format
  - Fixed column-width from the age of punch cards
  - Officially maintained by US CSEWG
  - Many Byzantine features due to long legacy with challenges for extensibility
- Subgroup 38 was created to agree the requirements for an international replacement 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*



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 45: VaNDaL

**Objective: To collect, review and QA inputs for nuclear data validation with integral experiments (primarily ICSBEP)**

- ICSBEP contains thousands of experiments, but simulation inputs (if they exist) are not designed for ND V&V
- Nuclear data community makes *extensive* use of these experiments, duplicating effort and introducing errors with modelling
- Thousands of inputs have been shared in SG45 (using NEA GitLab) and are used in cross-comparison, complemented by
  - Data stored in the NEA DICE databases
  - Other output / sensitivity / verification data generated by participants
- A new meta-format for model specification has been drafted, which can be used for serialisation into code-specific (e.g. MCNP) inputs
- With report on QA methods and other tools for inter-comparison, will be documented in SG summary report

SG45 Co-ordinator

Dr Wim HAECK

LANL, US

Monitor

Dr Andrej TRKOV

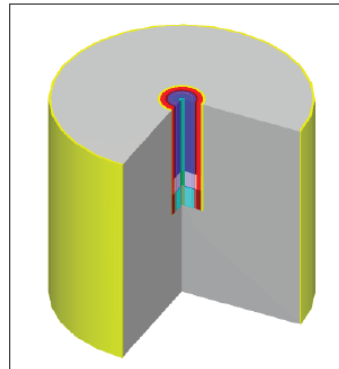
JSI, Slovenia



## Subgroup 46: TAR/Assimilation

**Objective: Update Target Accuracy Requirements (TARs) for nuclear systems and develop methods for integral ND feedback**

- Launched & led by Prof. Massimo SALVATORE, who sadly passed away 27 March 2020, with Dr. Giuseppe PALMIOTTI (INL, US)
- Feedback from applications/reactor community provides the focus for future work – the workflow is:
  - Accuracy requirements + S/UQ identifies priority needs (e.g. SG46)
  - Experimentalists review what can be achieved and add to HPRL
  - Experiments are run and taken into account for next library
- Several models have been included (LWR, SFR, LFR, ADS, etc.) with S/UQ calculations in progress – but more can be considered!
- Only simplified models are required to probe the nuclear physics needs



MYRRHA – $k_{eff}$ ISC (%/%)		
Quantity		JEFF-3.3
<sup>239</sup> Pu	v	$0.696 \pm 2.9 \cdot 10^{-6}$
<sup>239</sup> Pu	(n,f)	$0.482 \pm 2.9 \cdot 10^{-6}$
<sup>238</sup> U	(n, $\gamma$ )	$-0.112 \pm 3.7 \cdot 10^{-7}$
<sup>241</sup> Pu	v	$0.091 \pm 4.5 \cdot 10^{-7}$
<sup>240</sup> Pu	v	$0.081 \pm 4.5 \cdot 10^{-7}$
<sup>238</sup> U	v	$0.070 \pm 6.1 \cdot 10^{-7}$
<sup>241</sup> Pu	(n,f)	$0.064 \pm 4.6 \cdot 10^{-7}$
<sup>240</sup> Pu	(n,f)	$0.055 \pm 4.6 \cdot 10^{-7}$
<sup>239</sup> Pu	(n, $\gamma$ )	$-0.053 \pm 3.1 \cdot 10^{-7}$
<sup>209</sup> Bi	(n,n)	$0.052 \pm 1.1 \cdot 10^{-5}$



SG46 Co-ordinators

Professor Óscar CABELLOS  
Mathieu HURSIN

UPM, Spain and PSI, Switzerland

Monitors

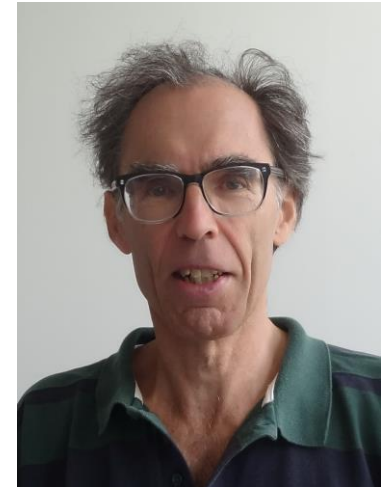
Dr Ajran PLOMPEN and  
Dr Andrej TRKOV

JRC-Geel and JSI, Slovenia

## Subgroup 47: SINBAD for Validation

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

- Many SINBAD experiments are (or could be) used for nuclear data testing/validation and integral feedback
  - Models are often limited in terms of overall description
  - Supplementary information is valuable for ND (MC weight window meshes for VR, CAD geometries, more detailed source terms/code mods, etc.)
  - Many SINBAD entries are complex and additional model information greatly improves the potential value for ND users and others



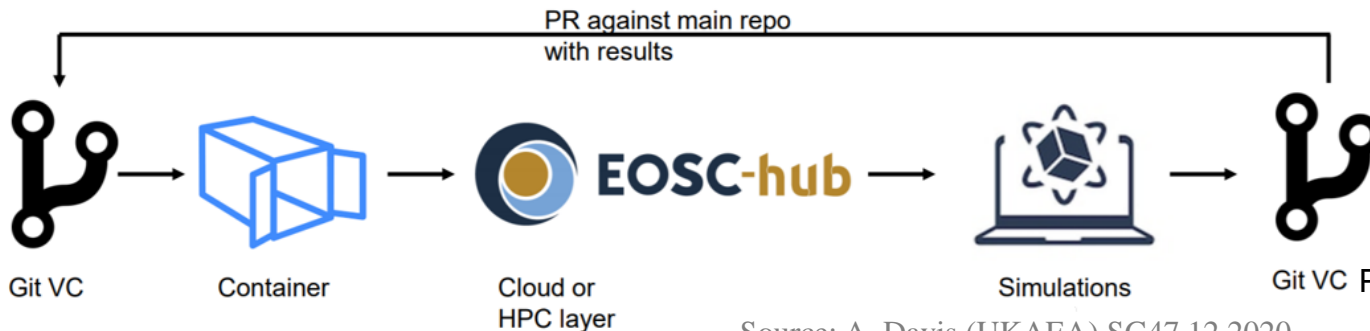
SG47 Co-ordinator

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

- **Enhanced co-operation with WPRS/EGPRS and new TF**

## Subgroup 48: Thermal Scattering

**Objective: To advance the state-of-the-art in thermal scattering evaluated data, processing and validation**

- Following success of SG42, which re-invigorated the field, many new advances are possible:
  - FOAK uncertainties – only possible with the new GNDS formats
  - Remove approximations applied in legacy formats and processing
  - Collaborate on modern, open-source processing for new TSL data
- SG42 and 2018 libraries demonstrated value and more communities are engaging:
  - Spallation source facilities (unique needs) SNS, ESS, ILL, ISIS, CNS
  - Better links with NRDC/EXFOR to improve stored experimental differential data
  - Collaborate on TSL validation methods - involve new types of integral measurements
- Kick-off on 13 May 2020 with 47 participants



SG48 Co-ordinator

Dr Gilles NOGUÈRE

CEA, France

Monitor

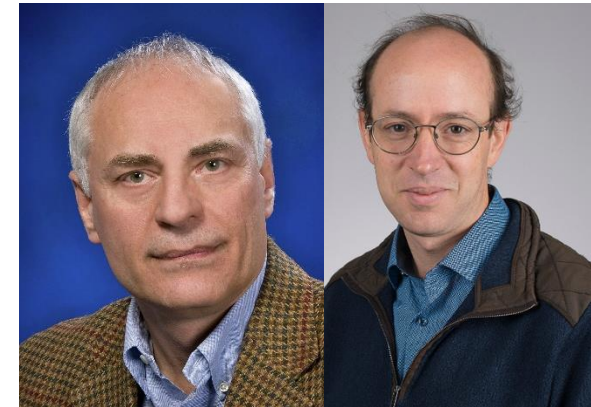
Professor Ayman HAWARI

NCSU, US

## Subgroup 49: Reproducibility

**Objective: Enable reproducibility in evaluation by documenting the processes and developing tools to store knowledge**

- Most evaluation work is practically impossible to reproduce
  - Counter to basic principles of scientific work
  - Looming challenge due to demographics of workforce
  - Technology will not solve the problem – but can help
- Establishing guidance for information required in the evaluation process (differs by component – e.g. energy range, isotope)
- Building a version-controlled system that takes the models, codes, scripts, data(bases) to ensure reproducibility
  - These will be used by library projects and coupled with automated testing systems – *ENDF and JEFF have launched GitLab projects*



SG49 Co-ordinators

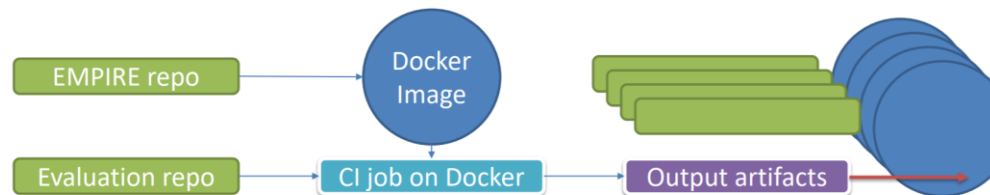
Dr Michal HERMAN and  
Dr Dimitri ROCHMAN

LANL, US / PSI, Switzerland

Monitors

Dr D. BROWN,  
Dr O. IWAMOTO,  
Prof. A. KONING

BNL, JAEA, IAEA



<https://git.oecd-nea.org/science/wpec/sg49/Evaluation-inputs>

## Subgroup 50: Experimental Database

**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 meetings held 2020/21 covering metadata, requirements (similar to IAEA ToF CM), NRDC co-ordination and 6 April 20201 for codes and databases



SG50 Co-ordinators

Dr Amanda LEWIS  
Dr Denise NEUDECKER

NNL and LANL, US

Monitor

Professor Arjan KONING

IAEA

# Thank you for your attention