

# ENDF Status

David Brown (BNL)

*USNDP Meeting, Virtual Nuclear Data Week 2020*

*3 Dec. 2020*

**BROOKHAVEN**  
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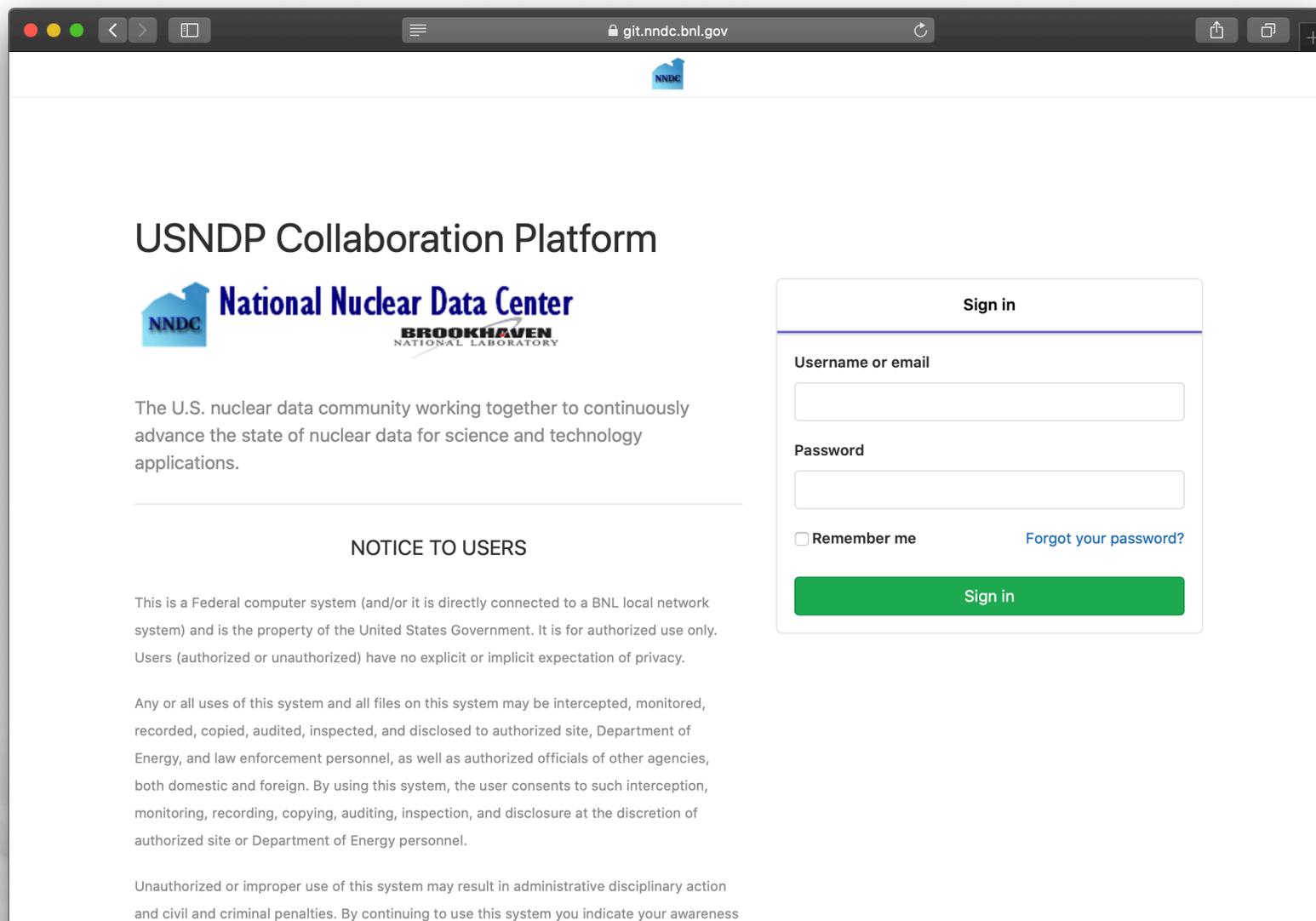
# What's going on in ENDF-space

- [git.nndc.bnl.gov](https://git.nndc.bnl.gov)
- Next ENDF Release
- Next ENDF format

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# We transitioned from GForge to [git.nndc.bnl.gov](https://git.nndc.bnl.gov)



The screenshot shows a web browser window with the URL `git.nndc.bnl.gov`. The page features the NNDC logo and the text "USNDP Collaboration Platform". Below this, the National Nuclear Data Center logo is displayed, along with the text "The U.S. nuclear data community working together to continuously advance the state of nuclear data for science and technology applications." A "NOTICE TO USERS" section follows, containing a disclaimer about the system's federal nature and privacy expectations. On the right side, there is a "Sign in" form with fields for "Username or email" and "Password", a "Remember me" checkbox, a "Forgot your password?" link, and a green "Sign in" button.

## USNDP Collaboration Platform



**National Nuclear Data Center**  
BROOKHAVEN  
NATIONAL LABORATORY

The U.S. nuclear data community working together to continuously advance the state of nuclear data for science and technology applications.

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Username or email

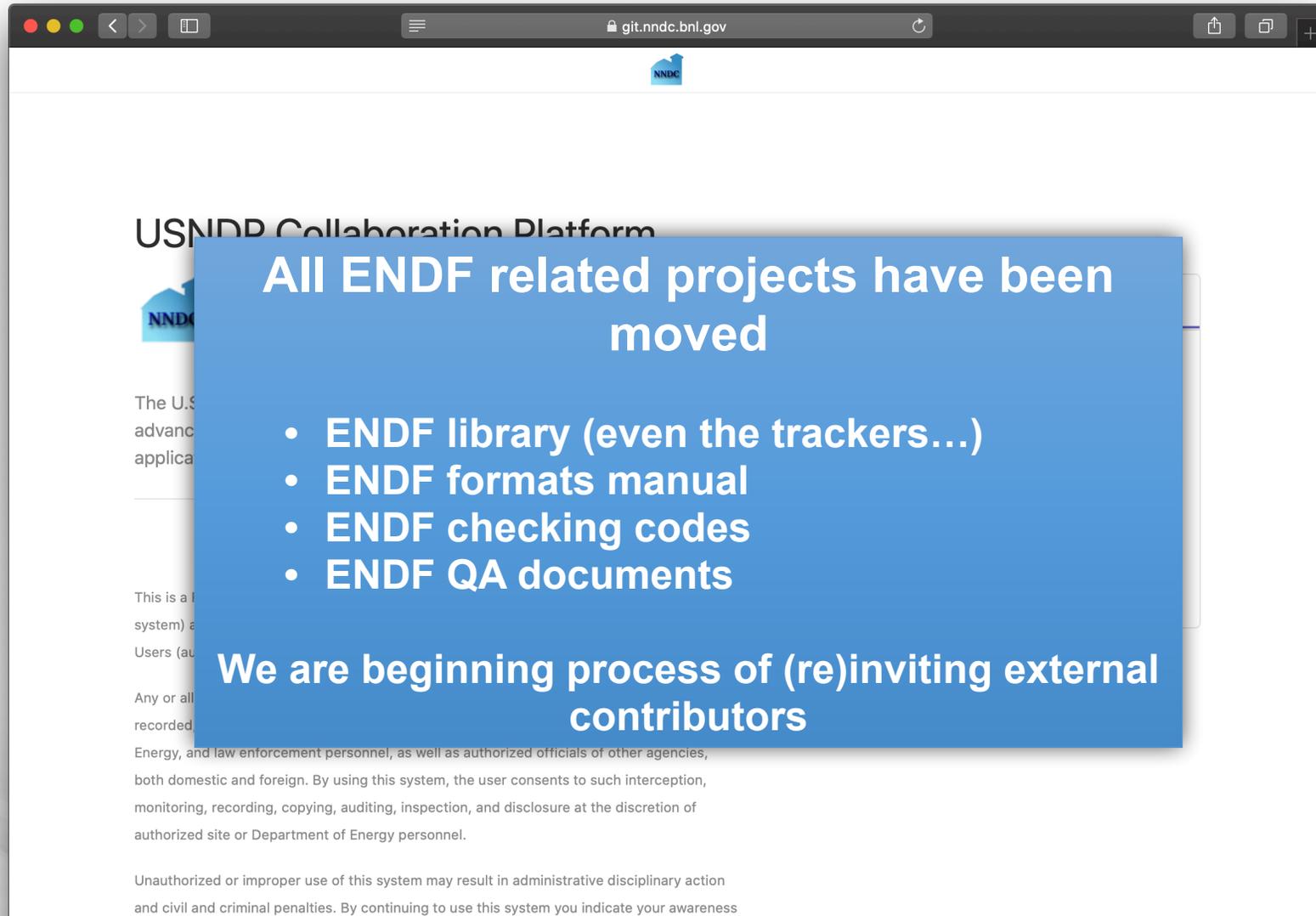
Password

Remember me [Forgot your password?](#)

**Sign in**



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The screenshot shows a web browser window with the URL `git.nndc.bnl.gov`. The page content is partially obscured by a blue overlay box. The overlay box contains the following text and list:

**All ENDF related projects have been moved**

- ENDF library (even the trackers...)
- ENDF formats manual
- ENDF checking codes
- ENDF QA documents

**We are beginning process of (re)inviting external contributors**

USNDD Collaboration Platform

The U.S. advanced applica

This is a (system) a

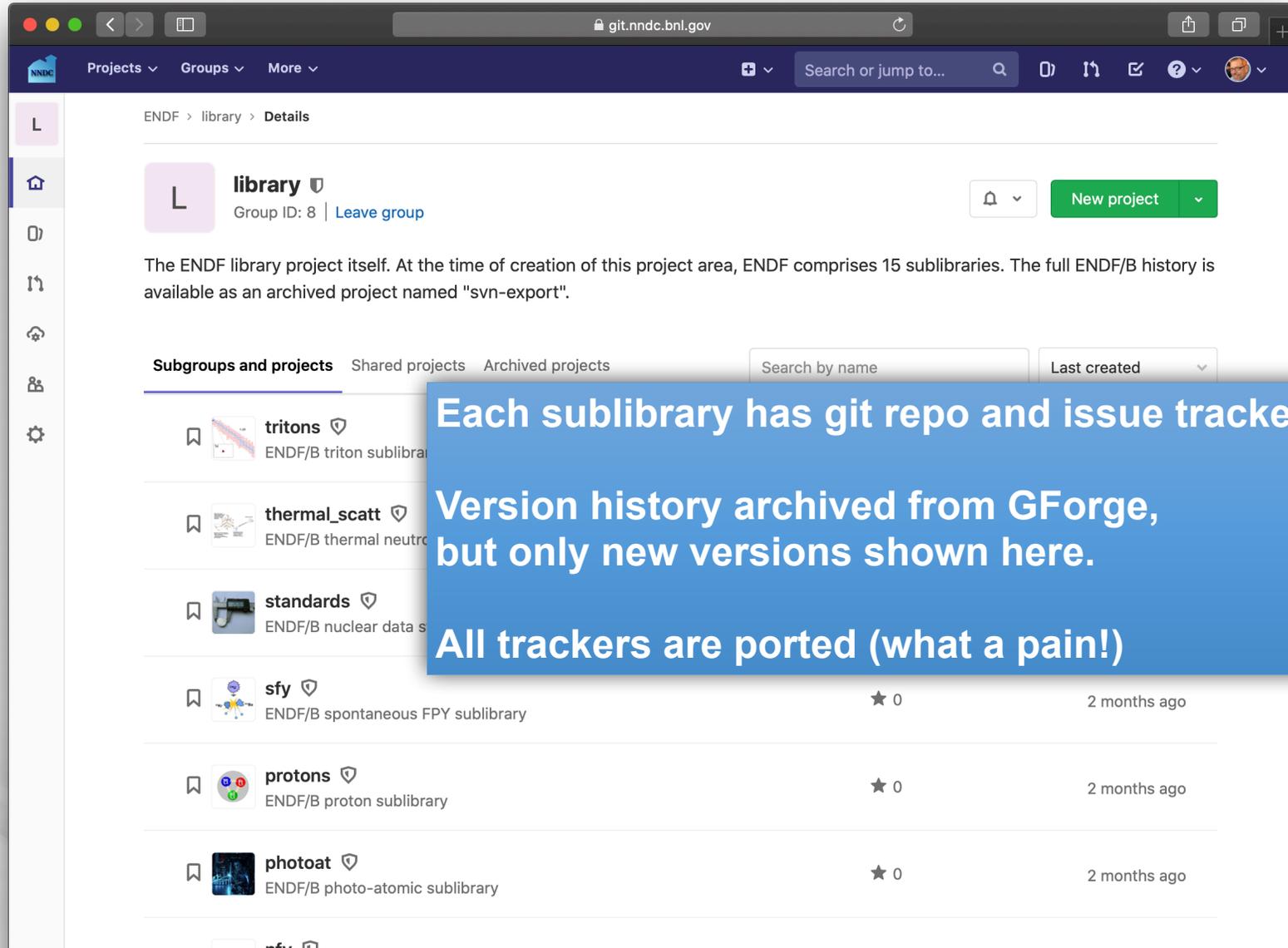
Users (au

Any or all recorded

Energy, and law enforcement personnel, as well as authorized officials of other agencies, both domestic and foreign. By using this system, the user consents to such interception, monitoring, recording, copying, auditing, inspection, and disclosure at the discretion of authorized site or Department of Energy personnel.

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# We transitioned from GForge to [git.nndc.bnl.gov](https://git.nndc.bnl.gov)



The screenshot shows the web interface for the 'library' group on git.nndc.bnl.gov. The page title is 'ENDF > library > Details'. The group name is 'library' with a shield icon, and the group ID is 8. A 'New project' button is visible. The description states: 'The ENDF library project itself. At the time of creation of this project area, ENDF comprises 15 sublibraries. The full ENDF/B history is available as an archived project named "svn-export".'

Below the description, there are tabs for 'Subgroups and projects', 'Shared projects', and 'Archived projects'. A search bar and a 'Last created' dropdown are also present. A list of sublibraries is shown, each with a bookmark icon, a name, a description, a star icon, and a date:

Sublibrary Name	Description	Stars	Created
tritons	ENDF/B triton sublibrary	0	2 months ago
thermal_scatt	ENDF/B thermal neutrons	0	2 months ago
standards	ENDF/B nuclear data standards	0	2 months ago
sfy	ENDF/B spontaneous FPY sublibrary	0	2 months ago
protons	ENDF/B proton sublibrary	0	2 months ago
photoat	ENDF/B photo-atomic sublibrary	0	2 months ago

Each sublibrary has git repo and issue tracker.

Version history archived from GForge, but only new versions shown here.

All trackers are ported (what a pain!)

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# We are aiming for the release of ENDF/B-VIII.1 in February 2023

## Motivations:

- It's been nearly 3 years since the release of ENDF/B-VIII.0
- There is a need for intermediate fixes (Fe, many others)
- INDEN evaluations on longer time scale, but many evaluations will be ready to go (Fe, Cr, Si)
- Sponsors (NCSP & NA-22 & others) would like to see results

## Why a minor release?

- There won't be a Standards in 2-4 years.
- Want new FPY evaluation too, but will take time

## Other issues

- New TSL evaluations break ENDF-6 & processing codes
- Looking at delay of few years so that processing codes can do GNDS.
- Staging the testing will be a problem given the changes to some files/libraries

# Color coding for new/planned evaluations

- Committed to phase1
- Soon to be committed to phase1
- Planned contribution
- **CONFLICT** 🤡 **angry words!**  
(Validation committee to sort out)

# Once again, TSL sublibrary undergoing major revisions

- New evaluations:

- FLiBe, HF, paraffinic oil (NCSU)
- UH<sub>3</sub>, Be<sub>2</sub>C, <sup>7</sup>LiD, <sup>7</sup>LiH, ZrH<sub>2</sub> ( $\epsilon$ -phase) (NNL)
- Si, Mg, Toluene, Mesitylene (phase II) (JEFF-3.3/CAB?)

- Revised evaluations:

- YH<sub>2</sub> (NNL), **conflict with RPI/ORNL?**

- New, but conflicting, evaluations:

- **Sapphire (NCSU vs. JEFF-3.3)**
- **Polyethylene (NCSU vs. RPI/ORNL)**
- **Light water ice I<sub>h</sub> (NCSU vs. RPI/ORNL vs. JEFF-3.3)**
- **Light H<sub>2</sub>O (CAB vs. NCSU)**
- **Lucite (NCSU vs. RPI/ORNL)**
- **ZrH ( $\delta$ -phase) (NNL vs. JEFF-3.3)**
- **CaH<sub>2</sub> (NCSU vs. JEFF-3.3)**

# Mass(ive) sublibrary changes

- **EPICS2017 tweak — atom\_relax, electrons, photoat revision from Red Cullen (uploaded by G. Nobre last week)**
- **SFY fixes (A. Mattera, BNL, September 2020)**
- **NFY fixes (A. Mattera, BNL, September 2020)**
- **Decay changes (R. Lorek, BNL, April 2020)**
- **2019 IAEA Photonuclear (G. Nobre uploading next week 😊, working through formatting issues)**

# Charged particle evaluations

- $p+^4\text{He}$  (LANL)
- $d+^4\text{He}$  (LANL)
- $^4\text{He}+^4\text{He}$ ,  $^4\text{He}+^6\text{Li}$  (LANL)
- $^4\text{He}+^9\text{Be}$ ,  $^4\text{He}+^{17}\text{O}$ ,  $^4\text{He}+^{18}\text{O}$  (NNL+IAEA)

# INDEN Evaluations

- $^{56}\text{Fe}$  fixes (IAEA)
- $^{55}\text{Mn}$  thermal capture spectrum (IAEA)
- $^{50,52-54}\text{Cr}$
- $^{235}\text{U}$ ,  $^{239}\text{Pu}$
- $^{28-30}\text{Si}$  (ORNL)
- $^{233}\text{U}$  (ORNL)
- $^{16,18}\text{O}$

# Non-INDEN neutron sublibrary

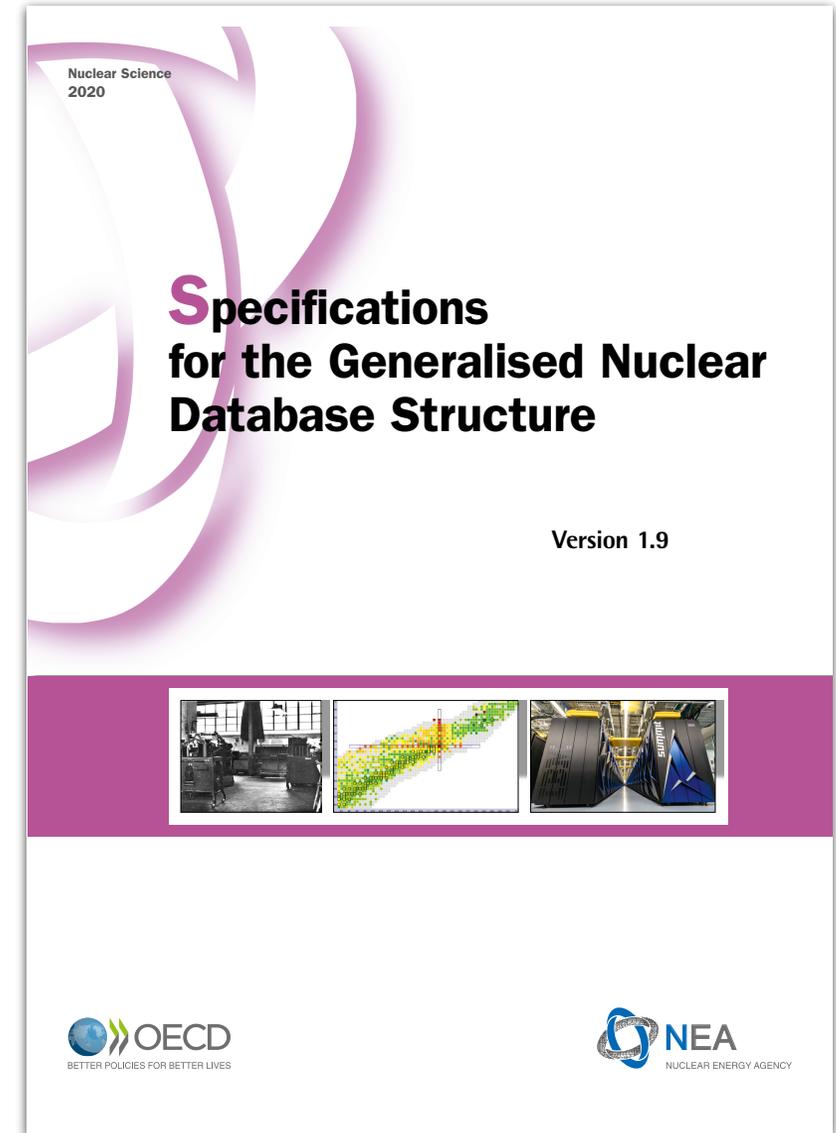
- $^{155,158,160-164}\text{Dy}$  (ORNL)
- $^{234,236}\text{U}$  (LANL)
- $^{181}\text{Ta}$  (LANL/NNL/RPI)
- $^{35}\text{Cl}$  (LANL)
- $\text{Hf}$  (RQW, BNL assist)
- $^{63,65}\text{Cu}$  (ORNL)
- $^{140,143}\text{Ce}$  (ORNL)
- $\text{Pb}$  (RPI+LANL)
- $\text{Np}$  (LLNL)
- Minor actinide nuclides (RQW, BNL assist)
- (x,CP) (LANL+KAERI)
- $^{106,108,110-112,114,116}\text{Cd}$  (LANL fix)
- $^{86}\text{Kr}$  (BNL)
- $^{170}\text{Tm}$  (BNL fix)
- $^{171}\text{Tm}$  (BNL fix)

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# GND-1.9 specifications published Summer 2020

- Specifications: <https://oecd-nea.org/download/wpec/documents/7519-GND-1.9.pdf>
- XML Schema for GND-1.9: <https://www.oecd-nea.org/download/wpec/gnds/gnds.xsd>
- GND-1.9 Webinar: <https://www.youtube.com/watch?v=h9Byrkxr8LE&feature=youtu.be>



# Thank you webinar participants

<https://www.youtube.com/watch?v=h9Byrkxr8LE&feature=youtu.be>

The NEA hosted an expert roundtable webinar on GNDS on 8 July 2020. The discussion was moderated by William D. Magwood, IV, NEA Director-General and Dr David Brown (BNL), Chair of the NEA Expert Group on the Recommended Definition of a General Nuclear Database Structure (GNDS). The panellists included:

- Dr Osamu Iwamoto (JAEA)
- Dr Jean-Christophe Sublet (IAEA)
- Dr Dorothea Wiarda (ORNL)
- Dr Caleb Mattoon (LLNL)
- Dr Fausto Malvagi (CEA)

**Nuclear data are the "secret sauce" that enable our understanding of nuclear systems**

Nuclear reactions are too complex to model from first principals and must be tabulated for use in simulations

The size and complexity of reaction data has increased markedly in the last 20 years

Year	Energy angle distributions	Energy distributions	Angular distributions	Charged particle reactions	Resonances	Uncertainties
1990	0.5	0.5	0.5	0.5	0.5	0.5
2000	1.5	1.5	1.5	1.5	1.5	1.5
2010	3.5	3.5	3.5	3.5	3.5	3.5
2020	15.0	15.0	15.0	15.0	15.0	15.0

VERA simulation of Xe-135 production in WB2 reactor core, from "Predictive Power" <https://www.ornl.gov/news/predictive-power> (2017)

# GNDS-2.0 Goals

- Satisfy remaining SG-38 goals
  - `<map>` format
  - `<documentation>` format (handled in May)
  - Major TNSL rewrite (handled in May)
- Ensure “forwards compatibility” with ENDF-6
- Respond to user needs
  - TNSL Covariance

## Detailed requirements for a next generation nuclear data structure

OECD/NEA/WPEC SubGroup 38\*

(Dated: June 28, 2016)

This document attempts to compile the requirements for the top-levels of a hierarchical arrangement of nuclear data such as found in the ENDF format. This set of requirements will be used to guide the development of a new data structure to replace the legacy ENDF format.

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\* Edited by D.A. Brown (dbrown@bnl.gov)

# What's next

- **Expect major format changes post-GNDS-2.0:**
  - Synchronize nuclear structure formats with ENSDF as part of ENSDF modernization
  - Revamp uncertainty/covariance to make more ML friendly
  - Atomic data additions
  - FPY formats per FIRE collaboration/CSEWG recommendations
- **ENDF to GNDS transition:**
  - ENDF/B-VIII.0 released in GNDS-1.9
  - Expect at least next release to be in both ENDF-6 and GNDS formats
  - Transition is slow; we must walk together and we can only go as fast as the slowest among us