

Status of ENDF

Gustavo Nobre, Dave Brown

November 18th, 2021

Topics

- GitLab: git.nndc.bnl.gov
- Meetings since last Nuclear Data Week: mini-CSEWG
- Next ENDF Release
- Updates in the ENDF library since last NDW
- Main challenges to be addressed

Before we start... 2020 CSEWG Minutes

Nuclear Data Week 2020 (CSEWG-USNDP-NDAG)

November 30, 2020 to December 4, 2020
Online
US/Eastern timezone

Overview

Timetable

Contribution List

Speaker List

My Conference

My Contributions

Registration

Participant List

Online meeting protocol

CSEWG Minutes

Support

✉ LKrejci@bnl.gov

✉ ahayes@bnl.gov

✉ bshu@bnl.gov

CSEWG Minutes

Meeting minutes from the CSEWG sessions



BNL-221549-2021-INRE

2020 Virtual CSEWG Meeting Minutes

G. NOBRE

May 2021

Nuclear Science and Technology Department
Brookhaven National Laboratory

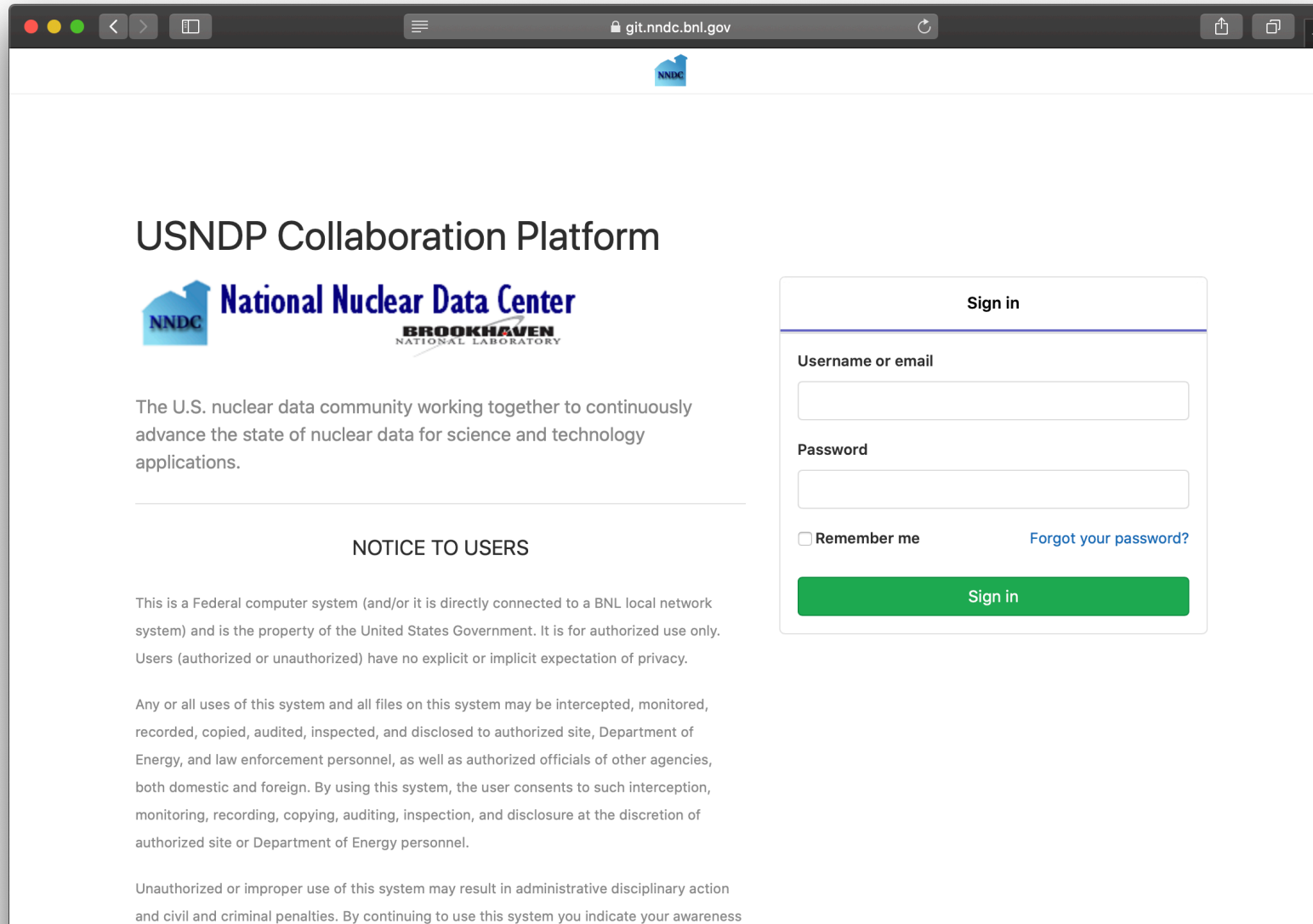
U.S. Department of Energy
USDOE Office of Science (SC), Nuclear Physics (NP) (SC-26)

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GitLab is fully operational!



The screenshot shows a web browser window with the address bar displaying `git.nndc.bnl.gov`. The page features the USNDP Collaboration Platform header, the National Nuclear Data Center logo, and a sign-in form. The sign-in form includes fields for 'Username or email' and 'Password', a 'Remember me' checkbox, a 'Forgot your password?' link, and a green 'Sign in' button. Below the sign-in form, there is a 'NOTICE TO USERS' section containing a disclaimer about the system's federal status and a consent statement regarding data interception and monitoring.

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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Sign in

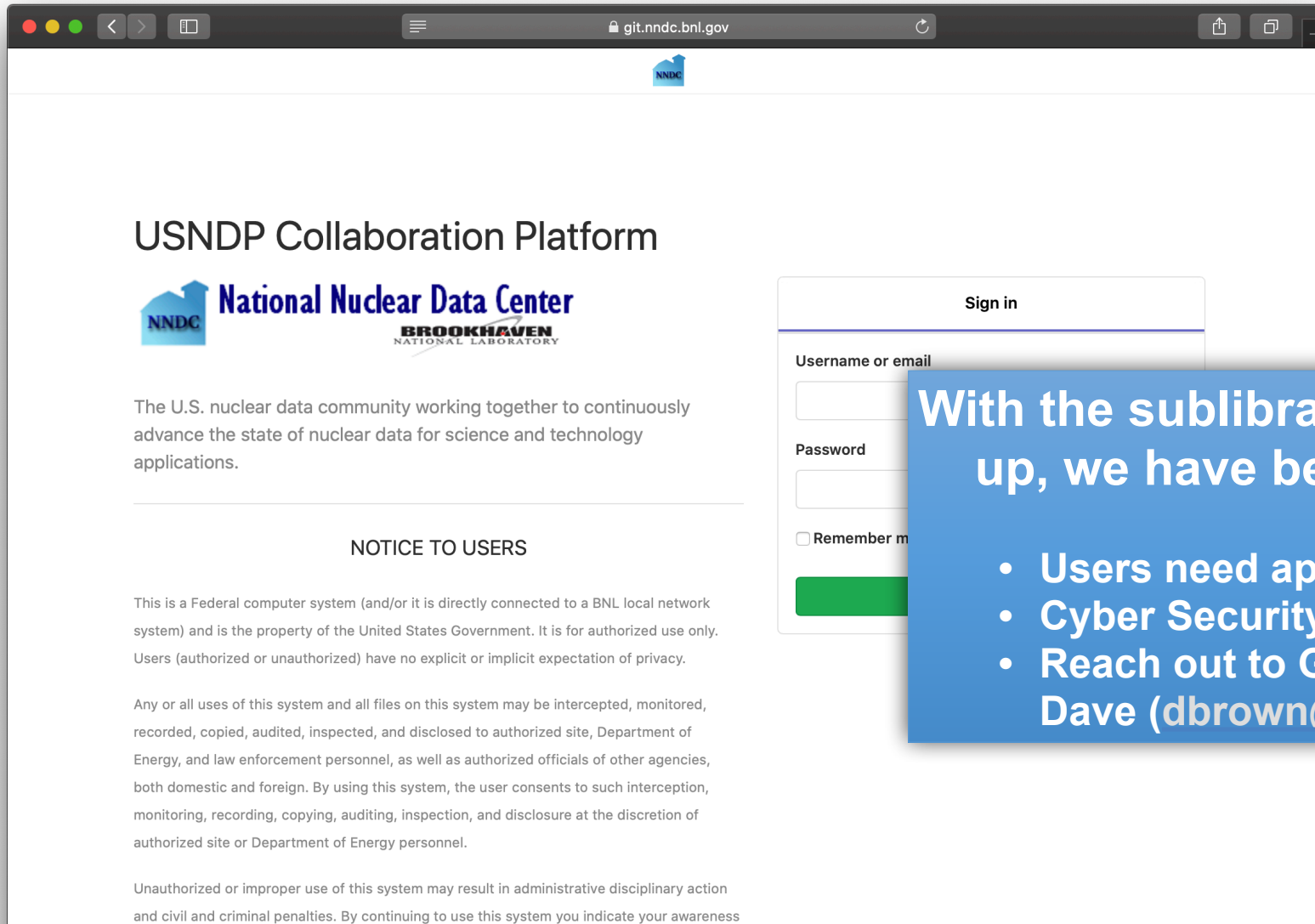
Username or email

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☐ Remember me [Forgot your password?](#)


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The screenshot shows a web browser window with the address bar displaying `git.nndc.bnl.gov`. The page title is "USNDP Collaboration Platform". Below the title is the logo for the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory. The logo consists of a blue house-like shape with "NNDC" inside, followed by "National Nuclear Data Center" in blue and "BROOKHAVEN NATIONAL LABORATORY" in black. Below the logo, there is a paragraph: "The U.S. nuclear data community working together to continuously advance the state of nuclear data for science and technology applications." Below this paragraph is a section titled "NOTICE TO USERS". The notice contains two paragraphs of text. The first paragraph states: "This is a Federal computer system (and/or it is directly connected to a BNL local network system) and is the property of the United States Government. It is for authorized use only. Users (authorized or unauthorized) have no explicit or implicit expectation of privacy." The second paragraph states: "Any or all uses of this system and all files on this system may be intercepted, monitored, recorded, copied, audited, inspected, and disclosed to authorized site, Department of 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." Below the notice, there is a paragraph: "Unauthorized or improper use of this system may result in administrative disciplinary action and civil and criminal penalties. By continuing to use this system you indicate your awareness". To the right of the notice is a "Sign in" form. The form has a title "Sign in" and two input fields: "Username or email" and "Password". Below the "Password" field is a checkbox labeled "Remember me". Below the checkbox is a green button.

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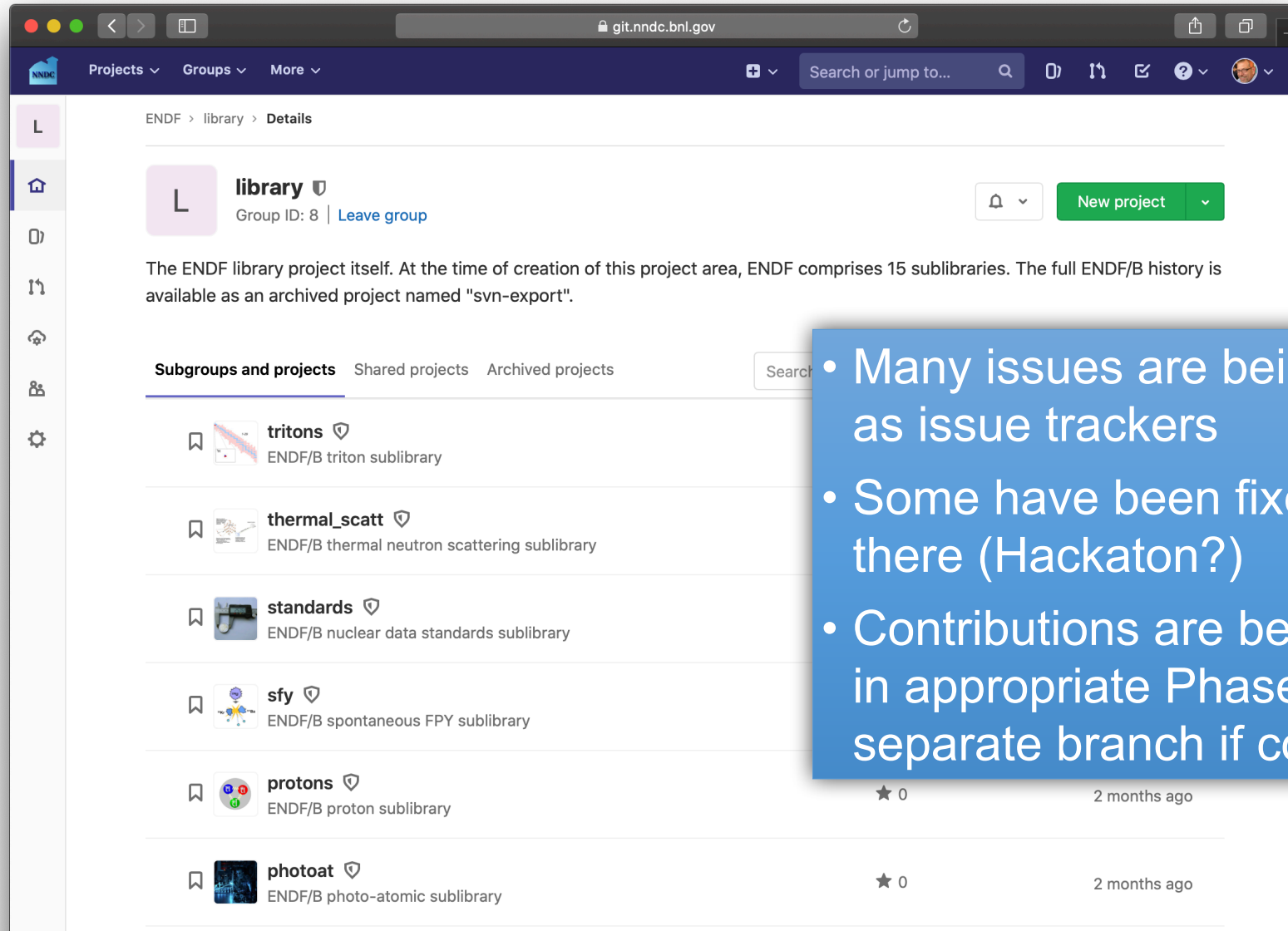
☐ Remember me



With the sublibraries and other projects set up, we have been adding contributors:

- Users need approved GIS
- Cyber Security training
- Reach out to Gustavo (gnobre@bnl.gov) or Dave (dbrown@bnl.gov)

GitLab is fully operational!



- Many issues are being found and logged as issue trackers
- Some have been fixed, many are still there (Hackaton?)
- Contributions are being sent and uploaded in appropriate Phase 1 branches (or separate branch if conflicting)

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We held a mini-CSEWG in August 2021

- Virtual
- DOE/SC PuRe initiative and ENDF implications
- Contributions for neutron, TSL, CP & photonuclear sublibraries
- Evaluation review
- Validation
- Discussion and poll: To adjust or not to adjust?

Mini Minutes for a mini CSEWG

16-19 August 2021

Mini minutes for a mini CSEWG
Virtual mini-CSEWG Meeting
16-19 August, 2021

Session chairs/document editors: D. Brown (BNL), G. Nobre (BNL), M. Chadwick (LANL), Y. Danon (RPI), T. Kawano (LANL), M. Pigni, M. Zerkle (NNL), D. Neudecker (LANL)

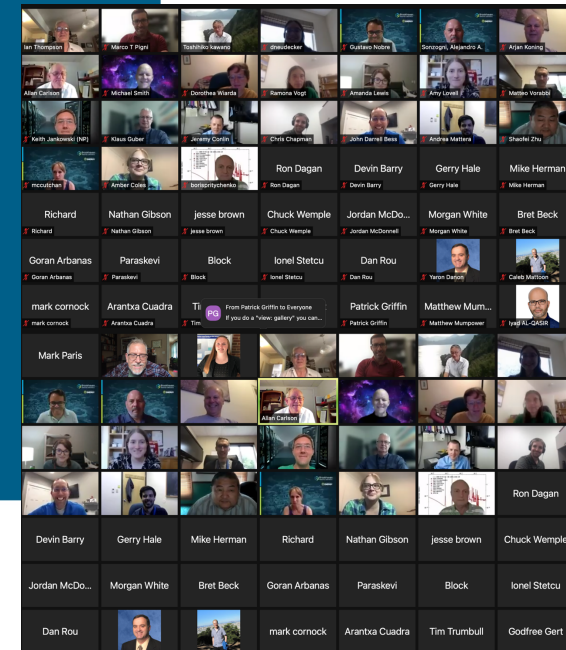


Figure 1: Zoom group photo from the mini-CSEWG meeting.

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- A dataset must have a “landing page” namely a website that allows access to the dataset in question
- Metadata describing the data
- The Metadata-Landing Page-Dataset linkage submitted to OSTI (BNL’s library does this last step). This linkage must be kept up to date even if either the metadata or landing page changes.
- Discussion about authorship/ownership of evaluations: GNDS can accommodate many of the needs, but details need to be sorted out

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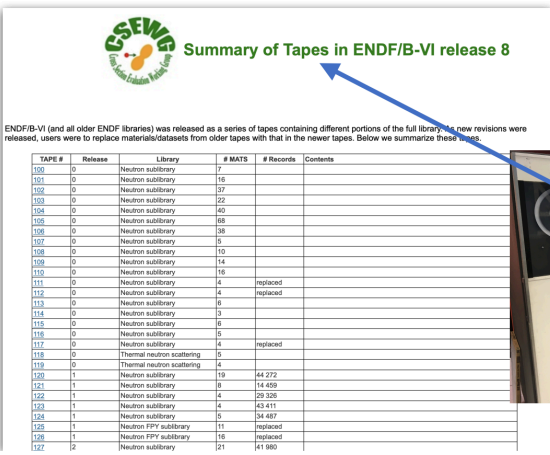
Action Items:

- Landing Page Items:
 - Cleanup and update ENDF web area
 - Define landing page URL scheme
 - Deploy ENDF landing pages (links to ENDF & GNDS, ACE?)
- Metadata Items:
 - Gather mandatory (and optional) metadata from all ENDF files
 - Assemble JSON-formatted metadata files for automated upload (these can be used to fill the fields in the GNDS files too)
 - Pilot DOI assignment with NSR, then ENSDF and ENDF
 - Hold EG GNDS meeting(s) to both finalize metadata tags and GNDS-2.0
- Other items:
 - Publicize (and use!) the generic ENDF library manager email

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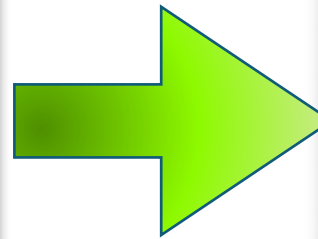
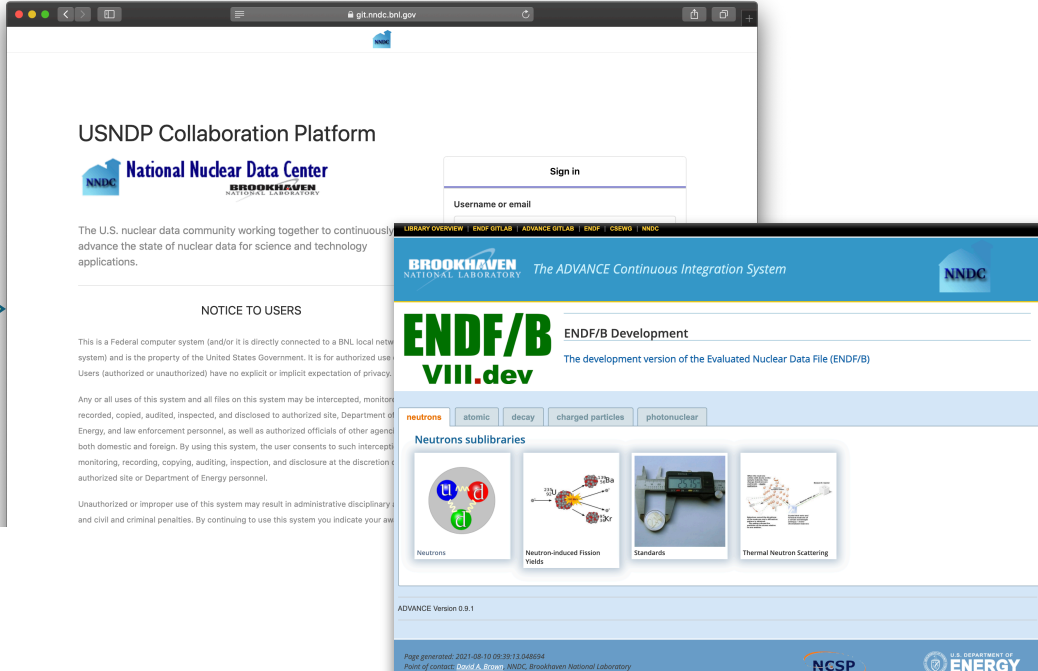
We held a mini-CSEWG in August 2021



CSEWG Summary of Tapes in ENDF/B-VI release 8

ENDF/B-VI (and all older ENDF libraries) was released as a series of tapes containing different portions of the full library. As new revisions were released, users were to replace materials/datasets from older tapes with that in the newer tapes. Below we summarize these tapes.

TAPE #	Release	Library	# MATS	# Records	Contents
100	0	Neutron sublibrary	7		
101	0	Neutron sublibrary	16		
102	0	Neutron sublibrary	37		
103	0	Neutron sublibrary	22		
104	0	Neutron sublibrary	40		
105	0	Neutron sublibrary	68		
106	0	Neutron sublibrary	38		
107	0	Neutron sublibrary	5		
108	0	Neutron sublibrary	10		
109	0	Neutron sublibrary	14		
110	0	Neutron sublibrary	18		
111	0	Neutron sublibrary	4	replaced	
112	0	Neutron sublibrary	4	replaced	
113	0	Neutron sublibrary	6		
114	0	Neutron sublibrary	3		
115	0	Neutron sublibrary	6		
116	0	Neutron sublibrary	5		
117	0	Neutron sublibrary	4	replaced	
118	0	Thermal neutron scattering	5		
119	0	Thermal neutron scattering	4		
120	1	Neutron sublibrary	19	44 272	
121	1	Neutron sublibrary	6	14 408	
122	1	Neutron sublibrary	4	29 528	
123	1	Neutron sublibrary	4	43 411	
124	1	Neutron sublibrary	5	34 487	
125	1	Neutron FPV sublibrary	11	replaced	
126	1	Neutron FPV sublibrary	16	replaced	
127	2	Neutron sublibrary	21	41 880	

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BROOKHAVEN NATIONAL LABORATORY The ADVANCE Continuous Integration System

ENDF/B VIII.dev ENDF/B Development

The development version of the Evaluated Nuclear Data File (ENDF/B)

neutrons atomic decay charged particles photonuclear

Neutrons sublibraries

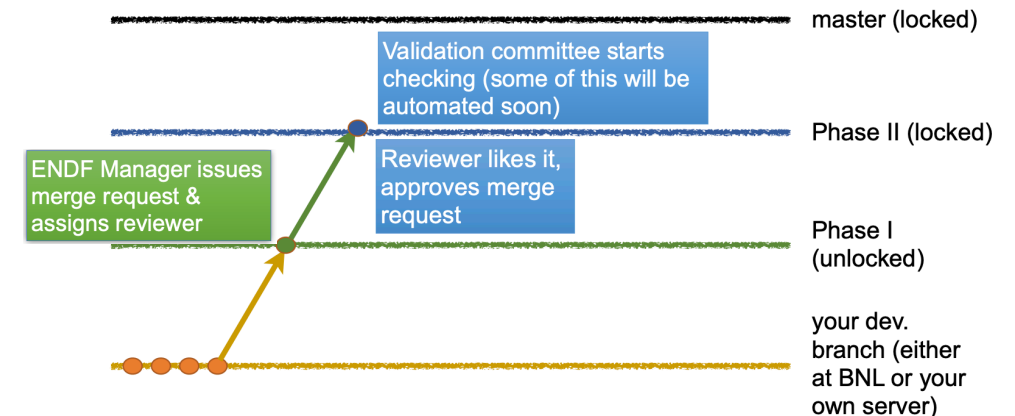
Neutrons Neutron-induced Fission Yields Standards Thermal Neutron Scattering

ADVANCE Version 0.9.1

Page generated: 2021-08-10 09:29:13.048204
Point of contact: David A. Brown, NNDC, Brookhaven National Laboratory

NCSP U.S. DEPARTMENT OF ENERGY

- Evaluation review
- Validation
- Discussion and poll: To adjust or not to adjust?



We held a mini-CSEWG in August 2021

- Validation
- Discussion and or not to adjust?

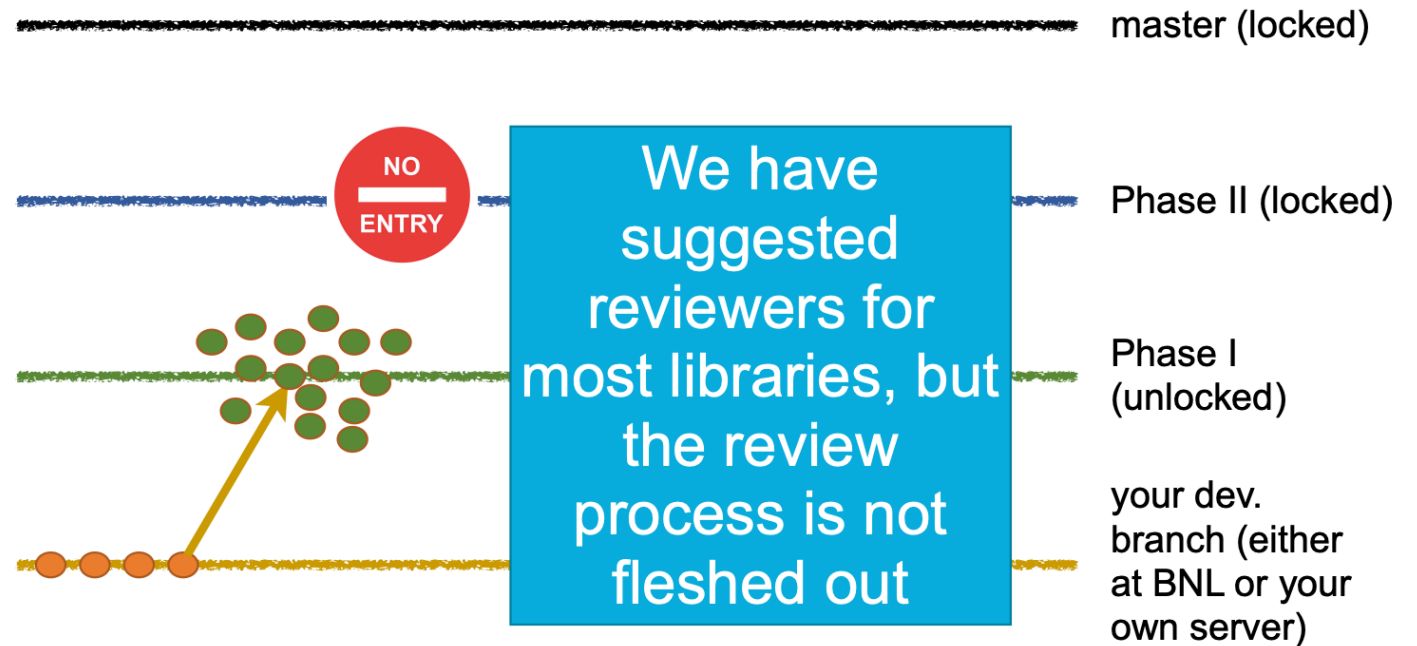


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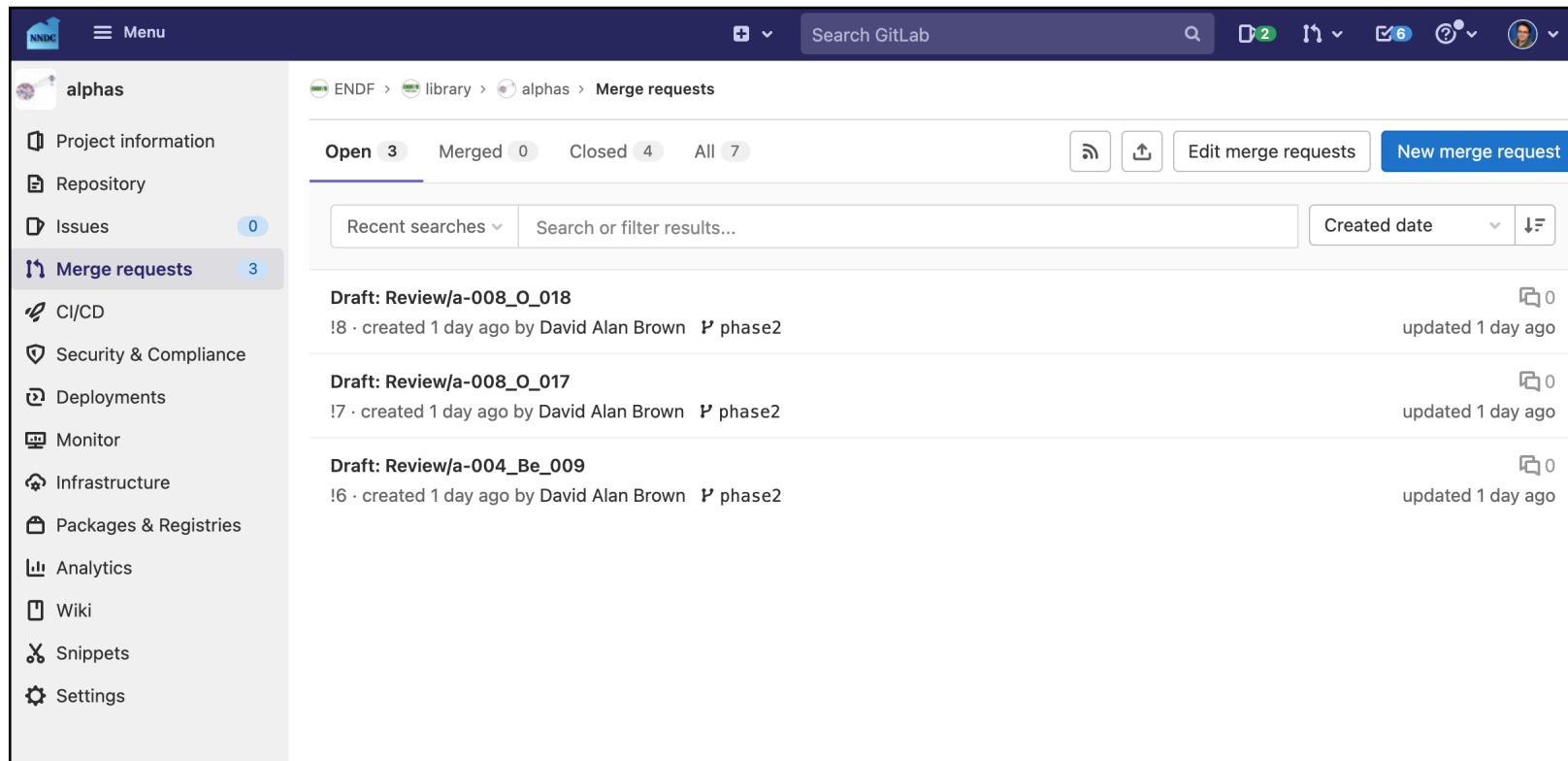
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Currently all ENDF/B-VIII.1 evaluations are jammed up in phase 1



Fresh news: Review system is working!

- Testing galore!



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- Testing galore!



The screenshot displays the NNDc review system interface. On the left is a sidebar menu with options: Menu, alphas, Project information, Repository, Issues, Merge requests, CI/CD, Security & Compliance, Deployments, Monitor, Infrastructure, Packages & Pipelines, Analytics, Wiki, Snippets, and Settings. The main content area shows a draft review for 'a-008_O_018' created 1 day ago by David Alan Brown (Owner). The draft title is 'Draft: Review/a-008_O_018'. Below the title are tabs for Overview (0), Commits (1), and Changes (3). The 'Overview' tab is active, showing 'Phase I Review' and 'ENDF/B-VIII.1, Alphas Sublibrary'. A list of details includes: Filename: a-008_O_018.endf, Sublibrary: Alphas, Material: 8-O - 18 (MAT=831), Evaluators: Holmes, Pavlou, Thompson, Zerkle, Submitter: David Brown, Submitter email: dbrown@bnl.gov, Review form generated at: 16/11/2021 19:40:30, Reviewer: (empty field), Reviewer email: (empty field), and Date: (empty field). At the bottom, a message states: 'You are being asked to review the evaluation for a-008_O_018.endf from branch phase1. The full ADVANCE test report for this evaluation is available at https://www.nndc.bnl.gov/endf/b7.dev/qa/alphas/a-008_O_018/a-008_O_018.html. Please edit this file on the Review/a-008_O_018 merge request tracker page at !8. You can do this simply by clicking the "edit" button and filling the empty fields. This document uses the Markdown format (see https://docs.gitlab.com/ee/user/markdown.html for a reference.)'. On the right side of the interface, there are buttons for 'request', a dropdown menu, and three comment icons, each with '0' and 'day ago' below it. The bottom left corner features the Brookhaven National Laboratory logo.

Fresh news: Review system is working!

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File Contents						
Questions to consider with each dataset: Is the current dataset an improvement over the existing dataset in the ENDF evaluation? Is the current dataset (e.g. cross section) some form of standard or reference? If so, how does the dataset compare to the reference? Does the current set take into account all relevant differential data? Data and covariance adequacy should be given on a scale of 0-5 with 5 being the highest. Use N/A if not given in the ENDF file.						
Reaction (MT)	1	3	6	Data Adequacy	Cov. Adequacy	Comments
451	X			<input type="text"/>	<input type="text"/>	<input type="text"/>
2		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
4		X		<input type="text"/>	<input type="text"/>	<input type="text"/>
16		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
22		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
50		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
51		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
52		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
53		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
54		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
91		X	X	<input type="text"/>	<input type="text"/>	<input type="text"/>
201		X		<input type="text"/>	<input type="text"/>	<input type="text"/>

ENDF > library

Open Created 1

Draft: Review

Overview 0 Co

Phase I Review

ENDF/B-VIII.1

- Filename: a-00
- Sublibrary: Alp
- Material: 8-O -
- Evaluators: Hol
- Submitter: Dav
- Submitter ema
- Review form ge
- Reviewer:
- Reviewer email
- Date:

You are being asked available at <https://w> merge request track

- Testing ga



- Project information
- Repository
- Issues
- Merge requests
- CI/CD
- Security & Compliance
- Deployments
- Monitor
- Infrastructure
- Packages & Modules
- Analytics
- Wiki
- Snippets
- Settings



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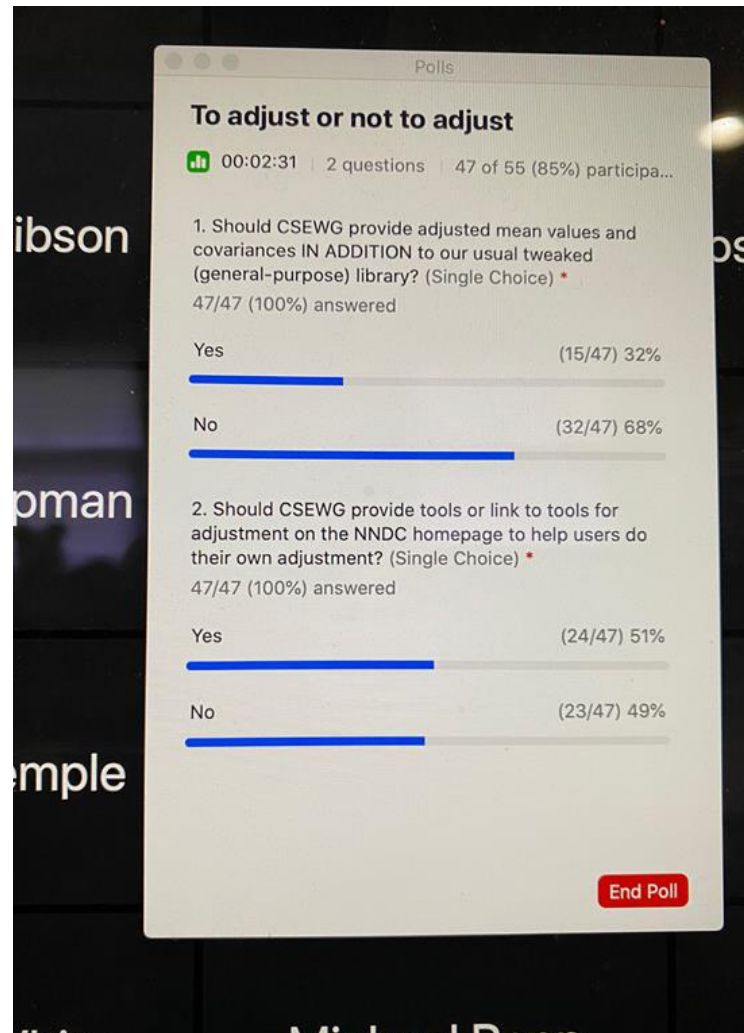
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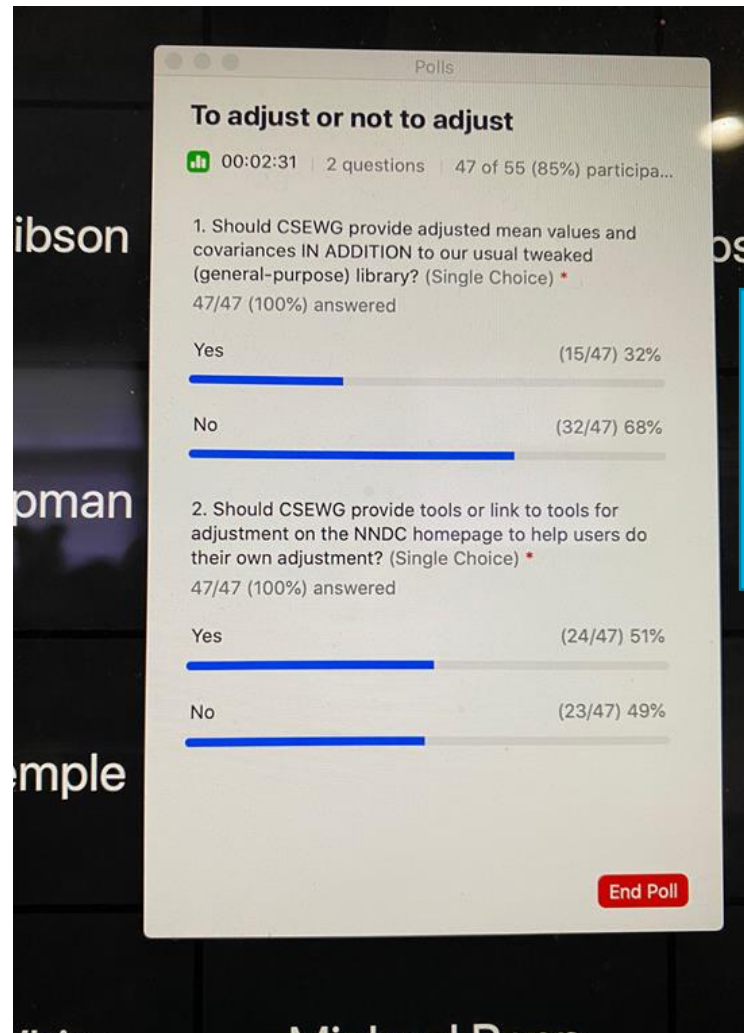
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We will NOT provide adjusted mean values and covariances in addition to the usual general purpose library.

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Next ENDF release

The release of ENDF/B-VIII.1 has been delayed...



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...for 1 year to Feb 2024!



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...for 1 year to Feb 2024!

- COVID pandemic delayed many experiments: New data are expected
- Need more time to setup proper review process
- Not enough time for proper testing and validation
- Time deal with a potentially serious issue at high reactor burn-up



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...for 1 year to Feb 2024!

- COVID pandemic delayed many experiments: New data are expected
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Accompanying Big Paper ready at around the same time!



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TSL sublibrary

- tsl_20pGraphite, tsl-AlinAl₂O₃, tsl-Be-metal, tsl-Be-metal+Sd, tsl-BeinFLiBe.endf, tsl-CainCaH₂.endf, tsl-CinSiC, tsl-CinUC, tsl-FinFLiBe, tsl-graphiteSd, tsl-H1inCaH₂, tsl-H2inCaH₂, tsl-HinCH₂, tsl-HinHF, tsl-LiinFLiBe, tsl-OinAl₂O₃, tsl-SiinSiC, tsl-UinUC (NCSU)
- tsl-7Liin7LiD-mixed, tsl-BeinBe₂C, tsl-CinBe₂C, tsl-Din7LiD-mixed, tsl-Hin7LiH-mixed, tsl-HinZrH₂, tsl-HinZrHx, tsl-ZrinZrH₂, tsl-ZrinZrHx (NNL)
- tsl-CainCaH₂, tsl-HinCaH₂ (from JEFF, conflict with NCSU), tsl-HinIcelh (JEFF, conflict with RPI), tsl-HinMesitylene-Phasell, tsl-HinToluene, tsl-Mg, tsl-Si (JEFF non-conflictive)
- tsl-CinC₅O₂H₈, tsl-CinCH₂, tsl-HinC₅O₂H₈, tsl-HinCH₂, tsl-HinIcelh, tsl-OinC₅O₂H₈, tsl-OinIcelh (RPI)
- tsl-CinCH₂, tsl-HinCH₂, tsl-HinH₂O (ESS)
- tsl-HinUH₃, tsl-NinUN, tsl-UinUN (ANL)

Neutron and decay sublibraries

- ^{56}Fe from IRSN (separate branch to not conflict with INDEN)
- ^{86}Kr (BNL)
- ^{78}Se , ^{97}Mo , ^{99}Tc , ^{102}Pd , ^{109}Ag , ^{113}In , ^{127}In , ^{133}Cs , ^{134}Cs , ^{134}Ba , ^{137}Ba , ^{138}La , ^{143}Pr , ^{147}Nd , ^{147}Pm , ^{153}Sm , ^{155}Eu , ^{160}Gd , ^{159}Tb , ^{166}Er , ^{168}Er , ^{170}Er , ^{175}Lu , ^{176}Lu , ^{174}Hf , ^{176}Hf , ^{177}Hf , ^{178}Hf , ^{179}Hf , ^{180}Hf (RQW + BNL)
- ^{103}Rh (RPI)
- $^{106,108,110,111,112,114,116}\text{Cd}$ (LANL)
- $^{233,235}\text{U}$ (INDEN)

- Format fixes from Paul Romano (whole sublibrary)
- ^{98}Zr , ^{56}Ba , ^{58}Ce (BNL - Lorek)

Files need to be reviewed, conflicts resolved, so they can be sent to Phase 2, validated, and finally, become a beta version of ENDF/B-VIII.1

Fission products

- R.Q. Wright and G. Nobre reviewed many stable or near stable fission products
- Cross-compared with JENDL, focused mostly in URR

Nuclide	MACS Values for 30 keV (mb)			
	VIII.0	JENDL-4	Revised	KADONIS
Se-78	90.9	83.5	68.0	60 ± 9.6
Mo-97	389.7	387.8	345.4	339 ± 14
Tc-99	1070	793	923.9	933 ± 47
Pd-102	459.1	288.8	367.3	393 ± 18
Ag-109	911.1	789.3	797.2	788 ± 30
In-113	924.3	696.4	785.5	787 ± 70
I-127	726.6	662.7	654.6	635 ± 30
Cs-133	465.3	540.8	510.6	509 ± 21
Cs-134	1159	542.9	620.1	724 ± 65
Ba-134	227.5	230.1	175.4	176 ± 6
Ba-137	58.8	63.7	78.6	76.3 ± 2.4
La-138	314	312.8	356.3	415 ± 59

Nuclide	MACS Values for 30 keV (mb)			
	VIII.0	JENDL-4	Revised	KADONIS
Pr-143	107.9	107.7	339.8	350 ± 86
Nd-147	836	997.4	607.6	544 ± 90
Pm-147	1050	705.6	705.3	745 ± 105
Sm-153	911.4	1049	1080	1095 ± 175
Eu-155	1136	1264	1440	1493 ± 94
Gd-160	171.3	186.5	181.6	190 ± 14
Tb-159	2080	1558	1565	1580 ± 150
Er-166	700.8	702.3	606.0	563 ± 56
Er-168	303.3	336.9	322.6	338 ± 44
Er-170	216.1	206.6	204.2	179 ± 7.1
Lu-175	1321		1259	1219 ± 10
Lu-176	1548		1775	1820 ± 79

Topics

- GitLab: git.nndc.bnl.gov
- Meetings since last Nuclear Data Week: mini-CSEWG
- Next ENDF Release
- Updates in the ENDF library since last NDW
- **Main challenges to be addressed**

Burnup issue

- Calculations with VERA benchmark found a loss of reactivity at high burnup, which discouraged adoption of VIII.0 by the nuclear reactor community.
- There are leads:
 - At the IAEA INDEN meeting, it was likely tracked down to a modest change in the $^{238}\text{U}(n,g)$ cross section in ENDF/B-VIII.0
 - The change may be correct. However, in the transition to VIII.0, ^{239}Pu was not updated
 - At high burn up, ^{238}U breeds ^{239}Pu and this compensates for the burning of ^{235}U
 - Other issues need to be clarified

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Nuclear Engineering



Article

Neutronic Characteristics of ENDF/B-VIII.0 Compared to ENDF/B-VII.1 for Light-Water Reactor Analysis

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JEFFDOC-????

Computational Burnup Calculations for ND Validation Activities

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JEFF Meeting - Depletion Session, November 25, 2021. O. Cabellos (UPM)

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Conflicting evaluations and TSL contributions

- ^{56}Fe :
 - INDEN solves leakage issue
 - IRSN: extend R-matrix to inelastic channel
- TSL (graphite, lucite...)
- TSL library is expanding
 - VI.8 had 15 TSL materials
 - TSL was unchanged from VII.0 to VII.1 (20 materials)
 - 14 TSL evaluations updated in VIII.0 (totaling 24 materials)
 - Library will be extended to ~30 materials in VIII.1
 - Ran out of MAT numbers: Approved format change to solve this

Conflicting evaluations and TSL contributions

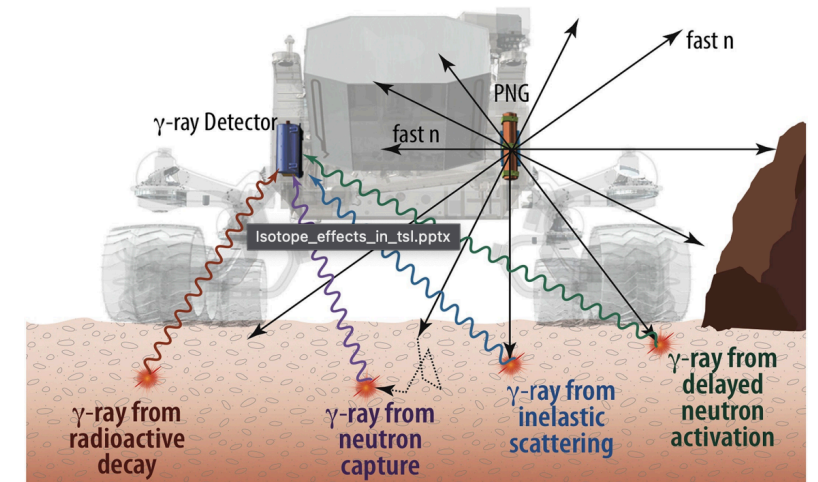
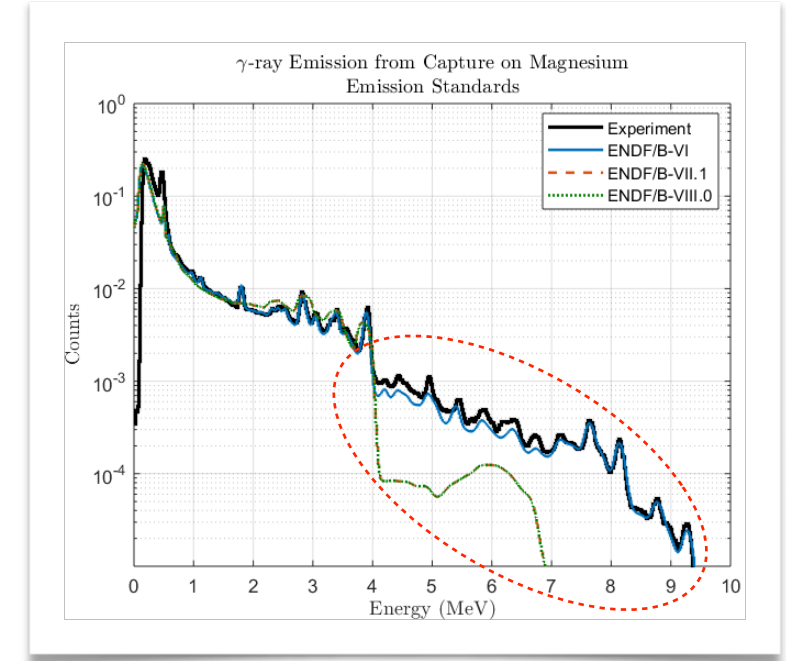
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TABLE I: Contents of the ENDF/B-VII.1 library, with ENDF/B-VII.0 and ENDF/B-VI.8 shown for comparison. NSUB stands for the sublibrary number in the ENDF-6 format. Given in the last three columns are the number of materials (isotopes or elements).

No.	NSUB	Sublibrary name	Short VII.1 name	VII.1	VII.0	VI.8
1	0	Photonuclear	g	163	163	-
2	3	Photo-atomic	photo	100	100	100
3	4	Radioactive decay	decay	3817	3838	979
4	5	Spont. fis. yields	s/fpy	9	9	9
5	6	Atomic relaxation	ard	100	100	100
6	10	Neutron	n	423	393	328
7	11	Neutron fis. yields	n/fpy	31	31	31
8	12	Thermal scattering	tsl	20	20	15
9	19	Standards	std	8	8	8
10	113	Electro-atomic	e	100	100	100
11	10010	Proton	p	48	48	35
12	10020	Deuteron	d	5	5	2
13	10030	Triton	t	3	3	1
14	20030	^3He	he3	2	2	1

Gamma spectra

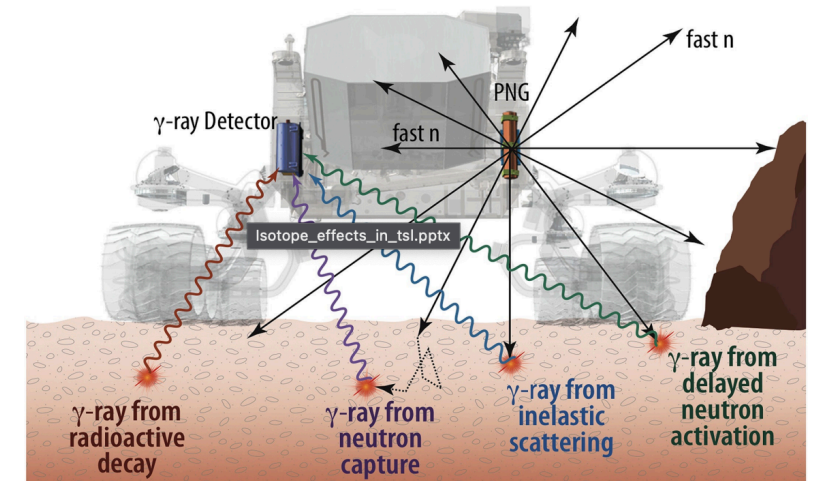
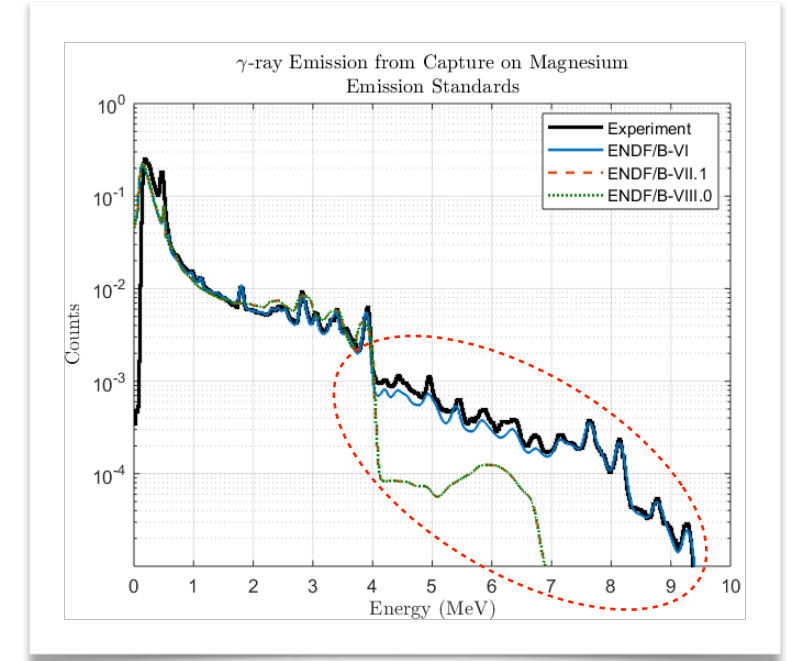
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- Worse agreement with data when transitioned from VI.8 (elemental) to VII.0 (isotopic)
- Quality of gamma spectra needs to be recovered (many, many applications!)



Gamma spectra

- Many strong disagreements between ENDF and ENSDF
- Worse agreement with data when transitioned from VI.8 (elemental) to VII.0 (isotopic)
- Quality of gamma spectra needs to be recovered (many, many applications!)

- ^{55}Mn INDEN evaluation showed a path to address these issues
- GRIN proposal is funded!!



Status of isotopes, Covariances, review process, other future work

- ^{239}Pu (Marco, Roberto)
- ^{181}Ta (M. Herman)
- Cu (T. Kawano, LANL)
- Planned Zr: ORNL + BNL
- Some neutron contributions still lack covariances

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We plan to go full-speed soon on the review process through GitLab

We will sketch out the future Big Paper: No evaluation left behind!