IAEA 60 Years
Atoms for Peace and Development

IAEA Nuclear Data activities

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WPEC-33 Meeting, May 13-14 2021, NEA, Boulogne-Billancourt

Contents

- Wrap up of 2018-2020
- CRP's, other meetings and Data Development projects
- Nuclear data dissemination

Some highlights 2018-2020 (slide from INDC-2021)

- Successfully completed/published CRPs:
  - Beta delayed neutron emission
  - Photonuclear data and photon strength functions
- NRDC, NSDD, INDEN networks very active: International Nuclear Data Evaluation Network (INDEN) launched, 3 meetings per year on light elements, structural materials actinides
- Several well-attended Technical Meetings, e.g. on anti-neutrino data, processing codes
- Updates of medical isotope production nuclear data: therapeutic, gamma and positron emitters
- Release of important nuclear data libraries
  - IRDFF-II nds.iaea.org/IRDFF
  - Photonuclear data library nds.iaea.org/photonuclear
- New database initiatives (CONDERC)
- Popular User Interfaces:
  - Isotope browser passed 120 000 downloads for Iphone/Android etc.
  - Medical Isotope Browser launched

Nuclear Data Development

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On-going Coordinated Research Project (2)

2) Updating Fission Yield Data for Applications

2020-2025, Capote, 1st RCM held (50+ partcipants)

Goals: Updated evaluations of Fission Product Yields including a full UQ will be developed for selected actinides in a broad range of incident neutron energies

- 1st RCM, IAEA, Vienna, 31st Aug.- 4th Sept. 2020 (virtual), **INDC(NDS)-0817**
  https://www-nds.iaea.org/index-meeting-crp/FissionYields2020/index.htm
  (50+ participants, 24 presentations)

Activities in four categories:

a Availabity of experimental fission product yield data for evaluations,

b New fission product yield experimental data,

c Fission product yield evaluation,

d Fission product yield validation.

Coordinators

a) Prytichenko
b) Serot
c) Capote/Mills (*)
d) Cabellos
* Minato: modeling SG

Data Development Projects

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3.- Verification of data processing codes for generating ACE-formatted files (NDS staff, CVs and SSAs)

- **Public evaluated nuclear data processing capabilities requested by MS CM** on Nuclear Data Processing Codes 5-8 Oct 2015
  - ✓ **GRUCON code** (Russia Kurchatov Institute)
  - ✓ **PrePro/ACEMAKER being developed (IAEA/NDS)**
  - ✓ **FUDGE (LLNL/BNL)**
  - ✓ **NJOY family (USA)**
  - ✓ **FRENDY (Japan)**
  - ✓ **GALILEE (France)**
  - ✓ **NECP-Atlas (China)**

Participants of the TM on Nuclear Data Processing

  - ✓ **TM on ND processing and intercomparison of ACE produced libraries held on 23-26 September 2019, Vienna, IAEA (fast range)**

nds.iaea.org/index-meeting-crp/TM-Nuclear%20Data%20Processing/

  - ✓ **The Importance of Resonance Self-Shielding, INDC(NDS)-0778, D.E. Cullen**
  - ✓ **The Importance of Resonance Self-Shielding - Part 2, INDC(NDS)-0814,** D.E. Cullen, D.L. Aldama, A. Trkov,
  - ✓ **Processing La-139 in the unresolved resonance region for FENDL library, INDC(NDS)-0825, D.L. Aldama and R. Capote**

Data Development Projects

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4.- R-matrix codes for Charged-Particle Reactions in the Resolved- Resonance Region (CVs, NDS staff, DT)

Three CMs held in 2015, 2016, and 2017.

4th CM on 27-29 August 2018:

- Inter-comparison of R-matrix codes and preparation of publication (AMUR, AZURE, CONRAD, EDA, GECCCOS, SAMMY, SFRESCO)
  After a rough start now all codes agree within 1-2%
- **Publication: Thompson et al., Eur. Phys. Jour. A 55, 72 (2019)**

5th CM on 13-14 May 2019:

- Test 2: inter-comparison of minimization techniques and calculation of covariances by different codes (AZURE, CONRAD, EDA, SAMMY, SFRESCO)
- Test 3: full evaluation of ^{7}Be system produced by: ^{3}He+^{4}He, p+^{6}Li
- **Results of global fitting of ^{7}Be with RAC: INDC(NDS)-0791**

Also important for INDEN: evaluations of light elements

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Portal entry

CoNDERC

Home Documentation Contributors Datasets

Compilation of Nuclear Data Experiments for Radiation Characterisation (CoNDERC)

The purpose of the CoNDERC project is to transfer into technology the experimental integral radiation information that can be used as part of the Validation and Verification processes of nuclear model and code systems, and to provide various schema to perform the V&V. Under the auspices of the IAEA Nuclear Data Section, individuals and institutions are assembling several of databases and code infrastructures based on their own V&V activities mainly associated with inventory, activation-transmutation, source term and radiation shielding R&D.

Decay Heat

Fusion Events

Fission Events

Spectra

Spectra

Shielding

Aspis FNS NIST

Oktavian Pulsed Replica

Tiara

Beyond Keff

MCNP

TRIPOLI

Experiments

Thermal Resonance

Baghdad Atlas

Reference Spectra

- NNP also: BWR and PWR in cycle at 600K not room temperature
- ESS, CERN, Maxwellian, Am-Be, Yayoi, Phenix, etc.

41	PWR-MOX-0	1102	n	PWR-MOX-0	PWR-MOX-0	NDS-139(2017)1-76
42	PWR-MOX-15	1102	n	PWR-MOX-15	PWR-MOX-15	NDS-139(2017)1-76
43	PWR-MOX-40	1102	n	PWR-MOX-40	PWR-MOX-40	NDS-139(2017)1-76
44	PWR-UO2-0	1102	n	PWR-UO2-0	PWR-UO2-0	NDS-139(2017)1-76
45	PWR-UO2-15	1102	n	PWR-UO2-15	PWR-UO2-15	NDS-139(2017)1-76
46	PWR-UO2-40	1102	n	PWR-UO2-40	PWR-UO2-40	NDS-139(2017)1-76
47	PWR-UO2-Gd-0	1102	n	PWR-UO2-Gd-0	PWR-UO2-Gd-0	NDS-139(2017)1-76
48	PWR-UO2-Gd-15	1102	n	PWR-UO2-Gd-15	PWR-UO2-Gd-15	NDS-139(2017)1-76
49	PWR-UO2-Gd-40	1102	n	PWR-UO2-Gd-40	PWR-UO2-Gd-40	NDS-139(2017)1-76
50	BWR-MOX-Gd-0	1102	n	BWR-MOX-Gd-0	BWR-MOX-Gd-0	NDS-139(2017)1-76
51	BWR-MOX-Gd-15	1102	n	BWR-MOX-Gd-15	BWR-MOX-Gd-15	NDS-139(2017)1-76
52	BWR-MOX-Gd-40	1102	n	BWR-MOX-Gd-40	BWR-MOX-Gd-40	NDS-139(2017)1-76
53	BWR-UO2-Gd-0	1102	n	BWR-UO2-Gd-0	BWR-UO2-Gd-0	NDS-139(2017)1-76
54	BWR-UO2-Gd-15	1102	n	BWR-UO2-Gd-15	BWR-UO2-Gd-15	NDS-139(2017)1-76
55	BWR-UO2-Gd-40	1102	n	BWR-UO2-Gd-40	BWR-UO2-Gd-40	NDS-139(2017)1-76
56	Phenix	172	n	Phenix	Phenix	CEA ERANOS
57	Superphenix	172	n	Superphenix	Superphenix	CEA ERANOS
58	Yayoi	107	n	Yayoi	Yayoi	EXFOR 23075
59	Frascati-NG	175	n	Frascati-NG	Frascati-NG	ENEA
60	TUD-NG	175	n	TUD-NG	TUD-NG	TUD
61	JAEA-FNS-pos3	175	n	JAEA-FNS-pos3	JAEA-FNS-pos3	JAEA MCNP
62	JAEA-FNS-pos1	175	n	JAEA-FNS-pos1	JAEA-FNS-pos1	JAEA MCNP
63	JAEA-FNS-pos2	175	n	JAEA-FNS-pos2	JAEA-FNS-pos2	JAEA MCNP
64	JAEA-FNS-pos7	175	n	JAEA-FNS-pos7	JAEA-FNS-pos7	JAEA MCNP
65	JET-FW	100	n	JET-FW	JET-FW	UKAEA McBend
66	ITER-DD	175	n	ITER-DD	ITER-DD	UKAEA
67	ITER-DT	175	n	ITER-DT	ITER-DT	UKAEA
68	NIF-ignition	150	n	NIF-ignition	NIF-ignition	MIT
69	LMJ-g	161	γ	LMJ-g	LMJ-g	CEA
70	DEMO-HCPB-FW	616	n	DEMO-HCPB-FW	DEMO-HCPB-FW	UKAEA
71	DEMO-HCPB-VV	616	n	DEMO-HCPB-VV	DEMO-HCPB-VV	UKAEA
72	DEMO-HCPB-BP	616	n	DEMO-HCPB-BP	DEMO-HCPB-BP	UKAEA
73	WCLL-FW	616	n	WCLL-FW	WCLL-FW	UKAEA
74	WCLL-VV	616	n	WCLL-VV	WCLL-VV	UKAEA
75	WCCB-FW	616	n	WCCB-FW	WCCB-FW	UKAEA
76	WCCB-VV	616	n	WCCB-VV	WCCB-VV	UKAEA
77	HCPB-FW	616	n	HCPB-FW	HCPB-FW	UKAEA
78	HCPB-VV	616	n	HCPB-VV	HCPB-VV	UKAEA
79	HCLL-FW	616	n	HCLL-FW	HCLL-FW	UKAEA
80	HCLL-VV	616	n	HCLL-VV	HCLL-VV	UKAEA
81	Maxwellian	709	n	1keV 10keV 30keV 5keV 80keV	Maxwellian	UKAEA
82	Maxwellian-25keV	30	n	Maxwellian-25keV	Maxwellian-25keV	EXFOR O1963
83	Am-Be	46	n	Am-Be	Am-Be	EXFOR 31724
84	ESS-2	117	n	ESS-2	ESS-2	ESS
85	CERN-H4IRRAD	288	n	CERN-H4IRRAD	CERN-H4IRRAD	CERN

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EXFOR and/or ENDF GUI's and API's

Request #2269 www-nds.iaea.org 2021-03-24,11:46:09
Access-Level=2 /pdf/ /db/ [11]
Results: Reactions: 7 Datasets: 41

Data Selection

Retrieve | Selected | Unselected | All | Reset
Output: X4+ EXFOR Bibliography TAB C4 PlotC4
Plot: Quick-plot (cross-sections) ungroup /product: Advanced plot [how-to] using C5 and convert ratios to σ
Narrow incident energy (optional), eV: Min: Max:
Apply Data re-normalization (for advanced users, results in: C4, TAB and Plots)

n	Display	Year	Author-1	Energy range,eV		Points	Reference	Subentry#	P	NSR-Key	Info+
1)	41-NB-93(N,EL) 41-NB-93,,DA C4: MF4 MT2										
	Quantity: [DA] Differential c/s with respect to angle										
1	+ i X4 X4+ X4± T4	1999	E.G.Christodoulou+	1.40e7		16	[pdf]+ J,NSE,132,273,1999	13804008 [4]	R33	/0 1999CH27	An[16]=16:161
2	+ i X4 X4+ X4± T4	1992	A.Takahashi+	1.41e7		16	[pdf]+ R,OKTAV-A-92-01,1992	22136016 [2]	R33	/0	An[16]=15:160
3	+ i X4 X4+ X4± T4	1991	R.S.Pedroni+	7.95e6	1.69e7	148	[pdf]+ J,PR/C,43,2336,9105	12995002 [4]	R33	/0 1991PE02	An[140]=18:162
4	+ i X4 X4+ X4± T4	1991	R.Finlay+	2.00e7		15	+ W,FINLAY,9111	13532002 [4]	R33	/0	An[15]=15:154
5	+ i X4 X4+ X4± T4	1991	Wan Dairong+	1.47e7		6	+ W,WANDAIRONG,199101	32523003 [8]	R33	/0	An[6]=3:14
6	+ i X4 X4+ X4± T4	1988	Cao Jianhua+	1.47e7		28	+ R,INDC(CPR)-011,125,198803	32521003 [8]	R33	/0	An[28]=6:151
7	+ i X4 X4+ X4± T4	1987	X.Wang+	7.00e6		9	[pdf]+ J,NP/A,465,483,8704	12892003 [4]	R33	/0 1987WA08	An[9]=30:140

Web interface very complete and detailed

But also API's under development for automated use

Goal: release command-line API's
(also for use in WPEC SG50)

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EXFOR for Applications

EXFOR-CINDA databases, retrieval systems, Endver/GUI package
for Linux, Windows and MacOSX using SQLite

Run software packages:

Preparation: Install JDK "1.7" or higher; + on MacOSX: install XQuartz
Download: https://www-nds.iaea.org/cdroms/#x4app2 ==> x4app-2020-04-07.tar.gz
Un-compress:

Windows: → Run → cmd.exe	Linux: → Terminal
> cd c:\x4app	MacOSX: → Finder → Applications
>"c:\program files\7-zip\7z.exe" x x4app-2020-04-07.tar.gz	→ Utilities → Terminal
>"c:\program files\7-zip\7z.exe" x -r x4app-2020-04-07.tar	$ tar xvzf x4app-2020-04-76.tar.gz
> cd x4app-2020-04-07	$ cd x4app-2020-04-07

	Run:	Windows	Linux	MacOSX
1	Interactive EXFOR retrieval system	run_x4cd.bat	./run_x4cd.sh	./run_x4cd-mac.sh
2	EndVer/GUI	run_endver.bat	./run_endver.sh	./run_endver-mac.sh
3	Non-interactive retrieval utility	cd app_example runme.bat	cd app_example ./runme.sh	cd app_example ./runme-mac.sh
4	EXFOR retrieval and converters	cd app_example2020 ./runme.sh	cd app_example2020 ./runme.sh	cd app_example2020 ./runme.sh

General description: readme.txt
How to use and setup: setup.txt
IAEA Nuclear Data Services: http://www-nds.iaea.org/

2020-04-07

International Atomic Energy Agency
Nuclear Data Services
2004-2020

for Windows, Linux, Mac
SQLite

EXFOR for Applications

EXFOR-CINDA databases and retrieval systems,
ENDVER/GUI integrated tools for ENDF-Evaluators
(Windows, Linux, MacOSX)
Version 2.1.1, April 2020

- ✓ Does not need installation
- ✓ Integrated CINDA and EXFOR
- ✓ Advanced interactive search
- ✓ Help based on Dictionaries
- ✓ Interactive graphics with ZVView
- ✓ Can work with local and remote databases
- ✓ Non-interactive EXFOR retrievals
- ✓ Converter from EXFOR to C4, C5, X4+, JSON, XML
- ✓ Examples of retrieval and converter scripts
- ✓ Real application: ENDVER/GUI package + EXFOR

EXFOR is a comprehensive library of experimental nuclear reaction data induced by neutrons, charged particles and photons.
Contents (2020-03-05): 23038 Entries, 33092 publications, 158739 data tables

CINDA library contains bibliographical references to experimental nuclear reaction data and to calculations, reviews, compilations and evaluations of neutron, charged particle reactions and spontaneous fission data. Includes import from EXFOR.
Contents (2020-03-09): 497717 lines, 68261 publications, 209927 blocks

Retrieval Systems on Java2: v1=2.1.1 (2020-04-02)

Alternative plotting tools

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LIBRARIES-2020 Data Explorer

File Download | Cross Section (Experiment vs Library) | Multiple Reaction Channels Cross Section | Residual Production Cross Section | Fission Yield

Cross Sections in ENDFTABLES and EXFORTABLES

Element: sr — e.g., C, c, Pd, pd

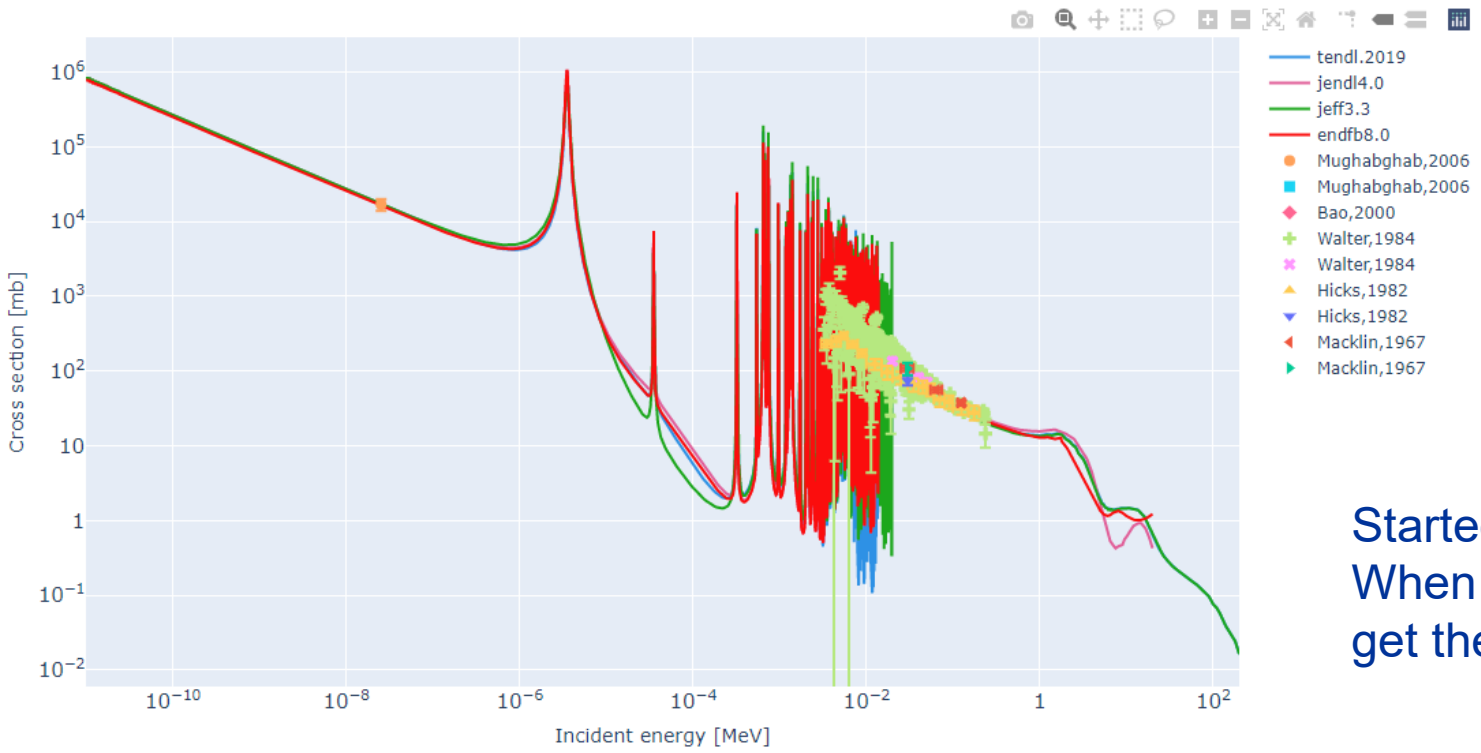
Mass: 87 — e.g., 0: natural, 242m: metastable state

Reaction: n,g

Chart | Data Table | Download

Plot for: Sr087(n,g) MF:3 MT:102, found 9 experimental data set(s).

X: ○Linear ◉Log Y: ○Linear ◉Log



Add more data to the chart by selecting entries from following table. Use filter function, e.g. >2000 in Year field

Started in March 2021.
When we are ready you get the URL

Towards a new NDS homepage

More modern look

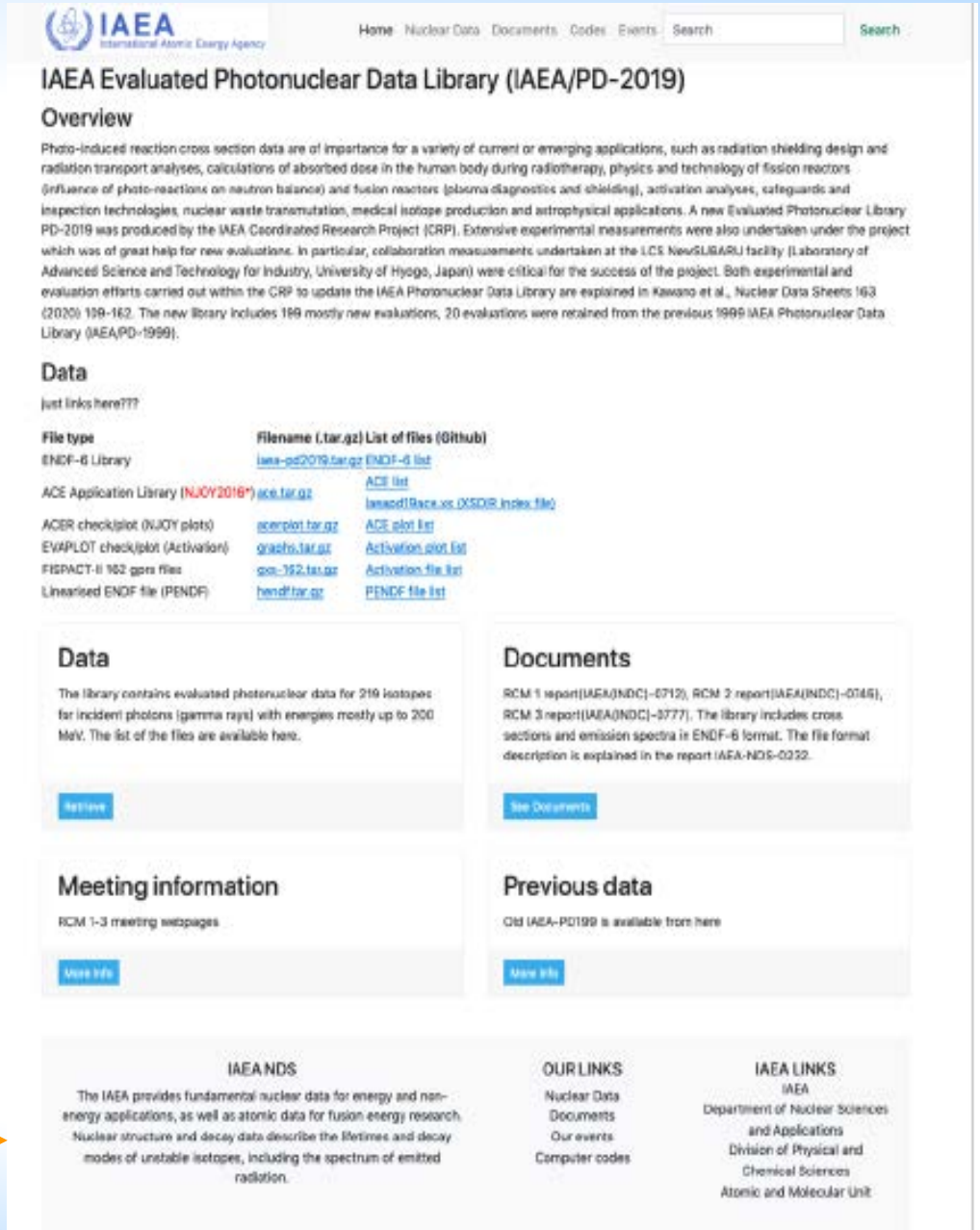
Requires detailed inventory of everything that exists: historical meetings, data libraries, etc

Build on consistent metadata for data libraries, meetings, documents and. **Restructure data files for future development** (data portals etc)

Important engines, e.g. EXFOR-ENDF retrieval will remain intact

Prototype expected before INDC June 2022

An example from last month which has already changed in the meantime



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Thank you!