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Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

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NUCLEAR ENERGY AGENCY
NUCLEAR SCIENCE COMMITTEE

Cancels & replaces the same document of 02 August 2016

Working Party on International Evaluation Co-operation

Twenty-eighth Meeting of the Working Party on International Nuclear Data Evaluation Co-operation

SUMMARY RECORD

12-13 May 2016
OECD Headquarters
Paris, France

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English - Or. English

WORKING PARTY ON INTERNATIONAL NUCLEAR DATA EVALUATION CO-OPERATION 28TH MEETING

OECD Headquarters, Paris, France

12-13 May 2016

SUMMARY RECORD

The WPEC chair, **M. Herman**, opened the meeting and welcomed all participants (a list is given in Annex 1). **O. Cabellos** acts as NEA/NSC WPEC secretary.

1. Adoption of the Agenda (NEA/SEN/NSC/WPEC(2016)1)

The proposed agenda was adopted.

2. Approval of the Summary Record of the 27th WPEC meeting (NEA/SEN/NSC/WPEC(2015)2)

The summary record of the twenty-seventh meeting was approved without modification.

3. Membership and observers

No comments.

4. Reports on experimental activities

Experimental nuclear data activities of relevance to the evaluation projects were reviewed. Detailed information about the experimental activities is given in the reports and viewgraphs presented at the meeting.

- *Europe*

  A. Plomp en reported on experiments in Europe from the last JEFF meetings. JRC-Geel: ^{7}Li(n,n'g), n+Fe, n+D, ^{238}U(n,γ) in RRR (for JEFF-3.3). Preliminary results for ^{6}Li(n,alpha) standard cross-section in GELINA. Fission process: mass and kinetic energy distributions VERDI-SCINTIA detectors (prompt neutron/gamma emission), IPCH/DNR (electron conversion measurements), Uppsala University (neutron-induced independent fission yields –IGISOL, nu-bar for ^{235}U and ^{237}Np, fission fragment properties), CEA(SOFIA collaboration – isotopic yields). Fission measurements: IPN at n_TOF for ^{235,238}U and ^{237}Np, ratio fission ^{238}U/^{235}U. SUBATECH and UPV(measurement of fission fragment beta decay properties-TAGS), GANIL

(isotopic fission yields in inverse kinematics). ENBG (surrogate-reaction method for measurement of gamma-decay and fission probabilities). Integral experiments: CEA (AMSTRAMGRAM Program in MINERVE –oscillation technique (e.g Am241), EXCALIBUR experiment – ^{238}U(n,inel)).

- *USA*

  Y. Danon reported on activities in the USA mostly based on presentation in CSEWG-Nov 2015 meeting. He summarized reports from different laboratories: 1) Nuclear Data Experiments at LANSCE (LANL): DANCE (^{235,236,238}U(n,γ), ^{242}Pu(spontaneous fission), capture cross-sections for ^{67,68}Zn, ^{136}Xe, ^{161,162}Dy, ^{173,174}Lu, ^{191,193}Ir)… currently enhancing LANSCE o work with isomeric states an predict correlation of prompt fission, GEANIE(^{187}Re(n,xn), ^{136}Xe(n,xn), ^{109}Ag(n,2n), neutron induced gamma-ray standard measurements), NIFFTE (235U fission fragments), SPIDER (thermal neutron fission fragment ^{235}U, ^{239}Pu and ^{252}Cf), TKE(^{235,238}U), Chi-Nu (PFNS for ^{235}U), …planned ^{16}O(n,α) new measurement. 2) ORNL Neutron Cross-Section Measurements Activities (ORNL): Ce and V (n,γ) measurements. 3) Nuclear Data Research at RPI (RPI): Transmission (W, Pb H2O, Fe, Ta), Scattering (Pb, Zr), capture (56Fe,natFe, Ta), Thermal neutron scattering(polyethylene). 4) NIST Measurements and Standards including Related Work at Other Facilities (NIST): H(n,n)H– Univ. Kentucky Van de Graaff, Ohio Univ., ^{6}Li(n,t), C(n,n), ^{238}U(n,γ), ^{238}U(n,fission).

- *Japan*

  H. Harada reported on nuclear data measurements performed at several accelerator and reactor facilities in Japan. J-PARC/MLF/ANNRI collaboration (^{99}Tc(n,γ), ^{157}Gd(n,γ), ^{nat}Au(n,tot), ^{241}Am(n,tot), ^{155,157}Gd(n,tot)), AIMAC collaboration (gamma-ray emission probabilities of ^{241,243}Am, ^{239,237}Np and ^{233}Pa), TANDEM (fission fragment mass distributions and PFNS), JAEA/FNS (Cu – already published in 2015- and Mo experiments), National Institutes for Quantum and Radiological Science and Technology (nuclear resonance fluorescence), Hokkaido University (Photon strength function), Tokyo Institute of Technology(capture cross-sections and gamma-ray spectra in the keV region for ^{89}Y and ^{128}Te), HIMAC (neutron production DDX from heavy-ion interactions).

- *Russian Federation*

  O. Grudzevich reported on nuclear data measurements performed in Russia. There are several projects: new accelerator 6 MV to measure threshold reactions, and new integral experiments at IPPE.

- *China*

  Xichao Ruan reported on China nuclear data measurement activities: 1) CIAE (fission yield measurements, (n,2n) cross-sections, (n,n'g) and (n,2ng) for iron, and measurements of the neutron leakage spectrum from slab samples for different angles with a 14 MeV d-T neutron source- e.g. results for carbon showed ENDF/B-VII.1 is much lower than this experiment. 2) Peking University (^{54,56}Fe(n,alpha) in the energy range 4-7 MeV), 3) ADS nuclear data measurements at IMP-CAS: (^{208}Pb(d,xn), ^{9}Be(d,xn)), 4) CAEP: (n,2n) reactions for ^{169}Tm, ^{85}Rb, ^{87}Rb, ^{140}Ce, ^{142}Ce, ^{197}Au, ^{238}U, ^{175}Lu, ^{89}Y and ^{185}Re.

5. Brief progress reports from the evaluation projects and discussion of future plans

Progress in the major nuclear data evaluation projects was presented. Detailed information about the status of the evaluated nuclear data libraries is given in the reports and viewgraphs presented at the meeting.

- *ENDF*

  M. Herman reported on the status of ENDF project. The ENDF/B-VIII/0beta1 is released in April 2016. Summary of changes to other sub-libraries since ENDF/B-VII.1 were commented. Testing and validation is presented performing adequately integral simulations with a base set of files. Future improvements in integral performance are still a goal. Much work will be also needed to add credible covariances. Expected released of ENDF/B-VIII in the 2017/2018 time frame. The ADVANCE system is presented as the quality assurance system for ENDF.

  Different activities are summarized: ORNL evaluations on W, Cu and Ca40. For Cu, the impact of the angular distribution and its resolution was discussed. Updates of the ENDF/B Decay Data (with TAGS data) and fission yields were discussed (e.g. effect on the calculation of antineutrino spectra. For modelling fission, advances in nuclear reaction theory for deformed nuclei were presented. Finally, he commented ORNL activities for the SAMMY modernization.

- *JEFF*

  A. Plompen presented the status of the JEFF File project. The JEFF-3.3T1 is released in April 2016 with 559 nuclides. Verification, processing and benchmarking activities are carried out. The JEFF-3.3 released is expected by the end of 2016, and the new Decay Data and Fission Yield data released by July 2016. He summarized the main changes since JEFF-3.2: CEA actinides (^{235,238}U and ^{239}Pu), new candidate for O16, evaluated by Luiz Leal, largely increased number of files with covariance, new evaluation for ^{63,65}Cu in the fast energy range, new evaluations for ^{209}Bi and ^{207}Pb from EU-CHANDA project… Benchmarking from different institutions (CEA, IRSN, NEA, …) are presented, and it may conclude that for ^{239}Pu and ^{235,238}U benchmarks results obtained with JEFF-3.3T1 are at least as good as with JEFF-3.2. **O. Cabellos** pointed out the new JEFF activities on Processing&Verification and Benchmarking&Validation. JEFF B&V working group is working to generate an open repository sharing Benchmarks outputs and inputs for Q&A pourposes, several instititutions are taking part of this activity: CEA, IRSN, PSI, KAERI, SCK, CIEMAT and NEA. For JEFF-3.3T2, it is expected the participation of Steven van der Mark with the complete suite of Benchmarks. He also informed that the new Luiz'O16 file (ENDF and ACE format) will be available for testing pourposes in JEFF-3.3T2 website, June 2016.

- *JENDL*

  O. Iwamoto and **K. Yokoyama** presented the current status of the JENDL project. **O Iwamoto** introduced the newly released libraries in 2015: JENDL/DDF-2015 (~3237 files) and JENDL-4.0/HE. JENDL-4.0/HE covers low-to-200 MeV, the isotope-production cross-sections are calculated with CCONE code obtaining reasonable results, it overcomes the problems in ^{2}H, ^{6,7}Li and ^{9}Be. New files: ^{204,206,207,208}Pb and ^{105}Rh. These files can be downloaded in the official JENDL website. JENDL/AD-2016 is the activation cross-section file for decommissioning of LWRs with 302 nuclides. **K. Yokoyama** introduced the Benchmarking toward next JENDL. The ongoing task is to develop a comprehensive and ready-to-use standard benchmark set, based on Japanese Monte-Carlo code MVP, for LWR nuclear data by utilizing open and well-evaluated integral experiments, such as ICSBEP and IRPhEP. It was observed significant dependency of H/Pu and H/U atomic number ratio between JEFF-3.2 and JENDL-4.0, to be investigated. Future activities are planned to automatize the benchmark execution systems and to extend the benchmark sets.

- *IAEA*

  A. Koning presented the activities of the IAEA Nuclear Data Section (NDS), including the international networks of nuclear reaction experiments (NRDC) and nuclear structure/decay data

evaluation (NSDD). He summarized EXFOR activities, compilation, verification visualization,… and the development of EXFOR-XML and possible unification with ENDF in frame of SG-38. NDS is leading evaluation activities (PFNS) and actively involved in CIELO project, he proposed to set up a CIELO network to continue this effort for more targets subject to availability of resources. CRPs activities were presented for medical applications, beta-delayed neutron emission, validation of IRDFF, primary radiation damage cross-sections,… New CRPS on RIPL for fission and photonuclear data.

- *TENDL*

  A. Koning reported on the status of the TALYS-based Evaluated Nuclear Data Library, towards TALYS-2.0 code. The last released TENDL-2015 in January 2016. He pointed out that the emphasis for TENDL now is equally on differential development and integral testing. For this version, new "best" TALYS input files are generated for each isotope, based on comparison with experimental data: thermal, RI, MACS, all other EXFOR data and integral activation measurements. Optimization continues until comparison with (differential and integral) experiments is at least as good as other libraries. This process goes from less important (easy) to important (challenging) nuclides. He emphasized the completeness and processibility of TENDL. Future versions of TENDL will be keen to adopt (essential parts of) CIELO nuclides.

- *ROSFOND/BROND*

  O. Grudzevich reported on the status of the BROND-3.1 including 372 complete files. The main features are: new cross-section measurements (^{50}Cr(n,alpha), ^{57}Fe(n,alpha)), new delayed-neutron yield measurements (^{235}U), some recent re-evaluations (^{209}Bi(n,γ)), adding covariance data for 140 files. Data verification with benchmarking in criticality and shielding benchmarks was presented: simulation of neutron leakage spectra from different spheres and calculated K-eff for fast uranium and plutonium critical assemblies. Tentative date of release is May 2016.

- *CENDL*

  Zhigang Ge presented the progress of CENDL project. He reviewed new evaluation activities for CENDL(^{6,7}Li, ^{40}Ca, ^{56}Fe, ^{108}Pd, ^{140,141,142,144}Ce, ^{236}U, …photonuclear data), methodological studies of nuclear data evaluation (light nuclei with FDRR code and LUNF code, few body theory, fission model, semiempirical model for fission yield, global prediction of microscopic optical potential, …), and nuclear data processing (RULER code).

6. Review of final or near-final subgroup reports

Results and conclusions of completed or near-completed subgroups were discussed. A summary table of all subgroup status is given in Annex 3.

- *Subgroup 27 (Prompt photon production from fission products)*
  This subgroup is closed. R. Jacqmin proposed to circulate the draft report before August. The final report would be issued in 2017.

- *Subgroup 28 (Processing of covariance data)*
  This subgroup is closed. M. Dunn has already sent a first draft report. The final report would be issued in 2017.

- *Subgroup 35 (Scattering angular distribution in the fast energy range)*

T. Kawano informed to O. Cabellos. The final report is in preparation. The final report will be issued by the end of 2016, to be published in 2017.

- *Subgroup 36 (Evaluation of experimental data in the resolved resonance region)*
  P. Schillebeeckx informed to O. Cabellos. The final report is in preparation. The final report will be issued by the end of 2016, to be published in 2017.

7. Status of ongoing subgroups

Activities of ongoing subgroups were presented. A summary table of all subgroup status is given in Annex 3.

- *Subgroup C (High priority request list for nuclear data)*

  A. Plompen reported on SG-C status. HPRL contains 37 entries, the recent one is ^{237}Np(n,fission). New entries (in preparation by SG40): U235,P239 prompt fission neutron spectra (PFNS), nu-bar, fission and inelastic cross-sections for Pu-239 and U-235.The new Special Purpose Quantities will be implemented at the new HPRL website, and new requests can be entered by the end of 2016. It was mentioned again the appeal for feedback to the project responsibles, SG-C and WPEC and ensure timely completion of the report and the mandate deliverables.

  For the new mandate, SG-C recommends to open the HPRL to other "Nuclear Applications". To be approved by NSC.

  The SGC chairman, A. Plompen, resigns after 12 years. A period to appeal for new candidates is open till 1st June that has gone out to WPEC members and the SG-C members. Emmeric Dupont (JEFF) presented his candidacy for the chairmanship. Emmeric Dupont, former secretary to SG-C when he was at NEA, is working at CEA having an important role for the nTOF collaboration in establishing projects of interest to applications. He has been supported by JEFF, ENDF and JENDL projects.

  T. Fukahori is agreed with minor changes in the Mandate to include new entries with high interest for "other nuclear applications". **M. Herman** mentioned the importance of this HPRL list, including other data such as structure nuclear data important in other applications. **M Chadwick** justified the motivation of new entries based on criticality/sensitivity discrepancies in integral benchmarks.

  M. Herman encouraged all projects to present candidates for chairman this important SG.

  (After the meeting, a period to appeal for new candidates is open till 1st June that has gone out to WPEC members and the SG-C members. Only one candidacy is presented for the chairmanship, Emmeric Dupont (JEFF). Emmeric Dupont, former Secretary of WPEC/SG-C, is now working at CEA having an important role for the nTOF collaboration in establishing projects of interest to applications. He has been supported by JEFF, ENDF, JENDL and CENDL projects as new chairman of Subgroup C).

  ACTIONS: New mandate 2016-2018 and new chairman.

- *Subgroup 37 (Improved fission product yield evaluation methodologies)*

  R. Mills reported on this subgroup: Recent experiments were discussed (TUNL, PROFIL, … SPIDER, STEFF,… IGISOL, SOFIA, VERDI…), new models and theory (GEF code and new physics model), and uncertainty/covariance methodologies. At this point, a part it was pointed out the difference on reactivity uncertainty using different methodologies. It was also remarked the new uses of fission yields (e.g. reactivity with burnup, anti-neutrino prediction, uncertainty quantification,…). The status of the SG37, "writing up" stage, after 4 previous meetings with 18 technical presentations, is working in the draft framework, to be finalised by January 2017.

  All: General consensus on the importance of the valuable work done by this SG.

  ACTION: Subgroup activities will continue until next WPEC meeting. Closing SG37 in 2017.

- *Subgroup 38 (A modern nuclear database structure beyond the ENDF format)*

  D. McNabb reported on progress made to define a new and improved standard structure for storing nuclear reaction data. SG38 has achieved excellent progress toward the development of a modern database structure/representation. Detailed requirements have been drafted in 3 documents on: "Basic numeric and text data", "Particle information "and "Reaction information". The specifications are mature enough to move forward with infrastructure development, and the documentation is ongoing on: "Terminology" and "Hierarchy".

  ACTION: Subgroup activities will continue until next WPEC meeting. Closing SG38 in 2017.

- *Subgroup 39 (Methods and approaches to provide feedback from nuclear and covariance data adjustment for improvement of nuclear data files).*

  G. Palmiotti reported on SG39 status. Two intermediate deliverables are ready for publication: "Summary of Methodology" and "Comments on Covariance Data". Other deliverables to be done by the next meeting. Regarding methodologies, the SG is developing new adjustment strategies for both: coping with the compensation issue and make more compatible with current calculational tools (continuous energy). Regarding experimental benchmarks, the SG is analysing and using new experiments of elemental and separation of effects type: PROTEUS, FCA-IX, SEG, ASPIS-88, SNEAK, MANTRA.

  Regarding Joint activities with CIELO project, it has been agreed the exchange of information between the two groups, in order to provide validation information to CIELO, based on the sensitivity analysis performed in SG39. Expecting feedback from CIELO in terms of more complete and reliable covariance data in the next future. Possible first CIELO covariance data release by March 2017.

  M. Herman pointed out that ENDF/B-VIIIb1will have tentative covariances by March 2017. For CIELO, covariances may be adopted from others or preliminary evaluations, or completely new data (e.g O16). Expected feedbacks for CIELO are for central values by the end of the 2016. Although, most of the work will be done for ND2016 conference.

ACTION: Subgroup activities will continue until 2016-2017 depending on progress. New meeting for this SG is planned in December 1-2, 2016 joint to JEFF meeting. Request to extend the mandate one year until 2017.

- *Subgroup 40 (Collaborative International Evaluated Library Organization Pilot Project)*

  M. Chadwick summarised the progress and understanding made by the different SG40-CIELO teams: ^{1}H, ^{16}O, ^{56}Fe, ^{235}U, ^{238}U, and ^{239}Pu. A set of starter files has been created via USA-IAEA-Europe collaboration. The main activities to improve physics have been on: 1) ^{235}U: PFNS and 100keV-2.25 keV (n, γ), 2) ^{16}O: changes for low-energy scattering and (n,alpha), 3) ^{56}Fe –many RR and fast advances, 4) ^{238}U: quality new resonance analysis, and 5) ^{239}Pu: changes beyond SG34.

  It was suggested to get frozen the CIELO nuclear data evaluation work by Nov 2016, so as to be consistent with documentation efforts: drafts by May 2017, to be completed by the next WPEC meeting, May 2017. These analyses will be documented in the coming year, including journal articles in Elsevier's Nuclear data Sheets (January 2018). This publication will be focused on more reaction physics activities performed in CIELO.

  CIELO has been recognized as a stimulating subgroup generating healthy collaborations and significant progress between regional evaluation projects. CIELO is working with other WPEC/SGs and experts providing important feedbacks for this work (integral validation testers, SG39, NEA tools- NDaST).

  A long-term solution to close this SG was also discussed in the meeting. IAEA has proposed to create a reaction data network for evaluators hosted at IAEA/NDS, being an extension of the CIELO project.

  ACTION: Subgroup activities will be completed by May 2017. Documentation in 2018. Request to extend the mandate one year until 2017.

- *Subgroup 41 (Improving nuclear data accuracy of ^{241}Am and ^{237}Np capture cross-sections)*

  H. Harada reported on SG41 status after the 2nd Meeting. During the meeting, the details on decay data, differential data, energy integrated data, and evaluations have been discussed, which are related to capture cross sections of ^{241}Am and ^{237}Np. Several important bias effects (origins of errors) have been identified for each measurement methods. The importance of up-to-dated decay data and differential data information were recognized for re-analysis of energy integrated data. In addition, the importance of sample quality including impurity information, precise quantification, and availability have been recognized. Finally, future actions needed for data improvements were discussed.

  The SG41's report will include sections on: 1) recommendation of energy dependent data, 2) re-analysis of energy integrated data, and 3) comments from evaluation viewpoint.

  ACTION: Report draft in March 2017. Closing SG41 activities in 2017.

- *Subgroup 42 (Thermal Scattering Kernel S(α,β): Measurement, Evaluation and Application)*

  S. Kahler reported on SG42 after the 1st Meeting. Around 20 participants were present discussing: data evaluations, measurements, theory-measurements connections, benchmarks, data formats and covariance data. Regarding TSL data in GND format, a link with WPEC/SG-38 activities has been stablished.

New evaluations will be released within the next 12 months, and are already available in the "ENDF/B-VIII.0β1 Thermal Kernels". New experimental activities are planned (or under discussions: cryogenic materials, UO2 in hot power conditions, H2O in critical point). Finally, upcoming release of the new version of NJOY will fix known issues in TSL modules.

ACTION: Subgroup activities continuing in 2017.

8. Proposals for new subgroups

The following subgroup proposal was reviewed by WPEC. Detailed information about this proposal is given in the document and viewgraph presented at the meeting.

D. McNabb presented the new proposal for a subgroup entitled *Subgroup 43: "Code infrastructure to support a modern general nuclear database (GND) structure"*. (see ANNEX 2.2). The code infrastructure is designed to support a general nuclear database structure. Fundamental needs are: 1) an Application Programming Interface (API) for reading and writing data in the new structure, and 2) checking codes to help validate new evaluations and fix problems identified during validation. These include checks for proper formatting and completeness.

It will enable international adoption of the new format. After completion, a long-term subgroup oversees these efforts.

ACTION WPEC has approved this new SG43 subgroup, request for NSC approval.

D. McNabb presented the new proposal for a *Long-term-B subgroup entitled: "International standard for a modern general nuclear database structure"* (see ANNEX 2.3). SG38 has developed a nuclear data structure standard that can meet the needs of a broad set of nuclear data users and providers. The GND format is reasonably mature, enough to work on infrastructure.
It will be necessary to establish an international governance body to endorse, promote, and maintain the new format as the future international standard. This standard will provide a framework for exchanging nuclear reaction data.
Main Task: 1) Approve and release the initial version, 2) Provide a productive environment to modify and extend the standard; 3) ensure that important and useful tools for using the new standard are developed and maintained, and 4) Release new versions with appropriate documentation as necessary.

A. Plompen pointed out that GND will be the format for the next generation of nuclear data libraries. JEFF-4 will be in both GND and ENDF6 formats, and tools allowing compatibility of new and old formats will be required in a transient period of time. **M. Herman**, also pointed out that ENDF/B-VIII will be in GND format.
T. Fukahori indicated the concern of users with the new format, and the need of workshops or trainings for educating on the new format. **O. Cabellos** has proposed NEA for organizing workshops for education and training in the new GND format.

(After the meeting, SG's participants agreed to change the title of this long-term SG in order to describe better the general scope of this activity. The final title is "Recommended definition of a modern general nuclear database structure"; no changes in the scope and objectives presented in the meeting).

ACTION: WPEC has approved this new long-term subgroup, request for NSC approval.

9. Conferences and meetings of interest to the nuclear data community

Forthcoming meetings of interest:

A. Plompen reminded the participants that JRC-IRMM organizes the next "*International Conference on Nuclear Data for Science and technology (ND2016)*" in Bruges, Belgium, 11-16 September 2016. More information is available at: http://www.nd2016.eu/

Two candidatures were presented to organize the "International Conference on Nuclear Data for Science and technology (ND2019)": China by Z.Ge, and Japan by H. Harada. WPEC support both Asian candidatures after ND2016 in Europe, and ND2013 in USA. Being the first time for China to host this International Nuclear Data Conference, WPEC supports China's bid to host the meeting (to be approved by NSC).

ACTION: Request for NSC approval ND2019 hosting candidature.

Other forthcoming meetings of interest to the nuclear data community are available on the WPEC web page at www.oecd-nea.org/science/wpec/calendar.html.

10. Any other business

The expiration date of this mandate is June 2016. No need to revise the "scope" or "objectives". It was agreed to renew the mandate for two-years until June 2018. "Deliverables" are revised to reflect the progresses made.

ACTIONS: WPEC committee approved a new mandate until June 2018 (see ANNEX 2.1), request for NSC approval.

11. Time and place of next meeting

The dates initially proposed, 18-19 May 2017. Subgroup coordinators will have the opportunity to hold short technical meetings the same week on 15-17 May 2017.

ANNEX 1

Participation to the twenty-eighth WPEC meeting
OECD Headquarters, Conference Center
2 Rue André Pascal, Room CC 20. Paris 75016 France
12-13 May 2016
Representatives from evaluations projects

Representatives from evaluation projects

Mark CHADWICK	ENDF / SG 40
Yaron DANON	ENDF
Mike DUNN	ENDF / SG 28
Mike HERMAN	ENDF / WPEC Chair
Albert (Skip) KAHLER	ENDF /SG42
Robert JACQMIN	JEFF / SG 27
Arjan PLOMPEN	JEFF / SG C
Tokio FUKAHORI	JENDL
Hideo HARADA	JENDL / SG 41
Osamu IWAMOTO	JENDL
Kenji YOKOYAMA	JENDL
Oleg GRUDZEVICH	BROND/ROSFOND
Zhigang GE	CENDL
Arjan KONING	IAEA / TENDL

Subgroup coordinators

Robert MILLS	SG 37 / JEFF
Dennis MCNABB	SG 38 / ENDF
Giuseppe PALMIOTTI	SG 39 / ENDF
Gilles NOGUERE	SG 42 / ENDF

Invitees

Xichao RUAN	CENDL
Haicheng WU	CENDL
Luiz LEAL	JEFF

Secretariat

Oscar CABELLOS	NEA

ANNEX 2

Documents presented at the twenty-eight WPEC meeting
OECD NEA Headquarters, Paris, France, 12-13 May 2016

ANNEX 2.1 Working Party on International Nuclear Data Evaluation Co-operation (WPEC); M. Herman (ENDF)

ANNEX 2.2 WPEC Long-term mandate (updated and extended) on a " Expert Group on the High Priority Request List for Nuclear Data"; E. Dupont (CEA/JEFF)

ANNEX 2.3 WPEC Subgroup proposal on a "Code infrastructure to support a general nuclear database structure"; Fausto Malvagi (CEA/JEFF)

ANNEX 2.4 WPEC long-term proposal on a "Recommended definition of a General Nuclear Database Structure"; David Brown (BNL/ENDF)

ANNEX 2.1 Working Party on International Nuclear Data Evaluation Co-operation (WPEC)

Chair: Michal Herman, ENDF project (USA)

Members: Representatives of the co-operating nuclear data evaluation projects, nominated by the projects

Date of creation: October 1989

Date of expiration: June 2019

Mandate:

– Revised and extended at the meeting of the NEA Nuclear Science Committee in June 2016 [NEA/SEN/NSC(2016)2]

Purpose, scope and membership

The goal of the Working Party is to improve the quality and completeness of evaluated nuclear data available for use in science and technology and to promote the efficient use of available resources through international collaboration.

The Working Party will consist of up to five representatives of each of the following four nuclear data evaluation projects: ENDF (United States), JEFF (NEA Data Bank member countries), JENDL (Japan), RUSFOND/BROND (Russia), as well as up to five representatives of non-NEA nuclear data evaluation projects, such as CENDL or TENDL. The participation from projects in non-NEA member countries will be channelled through the Nuclear Data Section of the International Atomic Energy Agency (IAEA). At least one member of each group will be a representative of the nuclear data measurement community, and another one a representative of the nuclear application community.

A Working Party chairperson shall be elected for a two-year period, with possible yearly extensions; the guiding principle being an alternating chairmanship between the ENDF, JEFF, JENDL and RUSFOND/BROND projects. Eligible candidates are representatives of the evaluation projects in NEA member countries.

Objectives

The Working Party will promote the exchange of information on all nuclear data related topics (i.e., evaluation, measurement, theory/modelling and validation) and foster the adoption of best practices. The Working Party will provide a framework for co-operative activities between the participating projects. The Working Party will assess the needs for nuclear data improvements and address those needs by initiating joint evaluation and/or measurement efforts. The improvements will be reflected in all major evaluated data files and will gradually help eliminate inconsistencies in these files.

In the three year period, the Working Party will set out to complete the following tasks:

- Recommend improvements in evaluated nuclear data (including covariance data) for fission and fusion applications, in response to indications from sensitivity & uncertainty analysis, integral validation/assimilation activities and new experimental/theoretical information;
- Recommend updates in codes, formats, methods and practices for further improving the nuclear data evaluation process and streamlining their processing and use;
- Monitor and update the “High Priority Request List for Nuclear Data” (HPRL) to stimulate specific nuclear data measurement and evaluation activities;
- Address any other emerging important nuclear data needs.

The Working Party will liaise closely with other Nuclear Science Committee activities to ensure that data

needs of nuclear science applications are properly addressed.

Deliverables

- An up-to-date version of the "High Priority Request List for Nuclear Data", accessible through the NEA Internet Web pages.
- A report on Prompt photon production from fission products (2017)
- A report on Processing of covariance data in the resonance region (2017)
- A report on Scattering angular distribution in the fast range (2017)
- A report on Evaluation of experimental data in the resolved resonance region (2017)
- A report on fission yield evaluation methodologies and recommended improvements (2017).
- A report on the development of a modern nuclear database structure beyond the current ENDF format (2017).
- A report on methods and approaches to provide feedback from nuclear and covariance data adjustments to evaluators and experimentalists (2017).
- A report on a joint assessment of six key isotopes – ^{1}H, ^{16}O, ^{56}Fe, ^{235,238}U, ^{239}Pu – in the framework of a pilot project of a Collaborative International Evaluated Library Organization – CIELO (2018).
- A report on improving nuclear data accuracy of ^{241}Am and ^{237}Np capture cross-sections (2017)
- A report on Thermal Scattering Kernel S(a,b): Measurement, Evaluation and Application (2018)

ANNEX 2.2 WPEC Long-term mandate (updated and extended) on a "Expert Group on the High Priority Request List for Nuclear Data"

Chair:	Dr Emmeric Dupont
Members:	Representatives of the co-operating nuclear data evaluation projects (ENDF, JEFF, JENDL, ROSFOND/BROND) or NEA member countries
Observers:	International Atomic Energy Agency (IAEA), *By agreement* Chinese Evaluated Nuclear Data Library (CENDL) Project, *By invitation*
Date of creation:	May 1991
Duration:	June 2018

Mandate

- Agreed at the 16th meeting of the Working Party on International Nuclear Data Evaluation Co-operation [NEA/SEN/NSC/WPEC(2004)2]
- Extended mandate as a part of WPEC activities at the 23rd meeting of the Nuclear Science Committee in June 2012 [NEA/SEN/NSC(2012)3]
- Revised and extended at the meeting of the NEA Nuclear Science Committee in June 2013 NEA/NSC/DOC(2013)2]
- Revised and extended at the 26th meeting of the Working Party on International Nuclear Data Evaluation Co-operation [NEA/SEN/NSC/WPEC(2014)2] and endorsed by the NEA Nuclear Science Committee in June 2014 [NEA/SEN/NSC(2014)2]
- Revised and extended at the 28th meeting of the Working Party on International Nuclear Data Evaluation Co-operation [NEA/SEN/NSC/WPEC(2016)2] and endorsed by the NEA Nuclear Science Committee in June 2016 [NEA/SEN/NSC(2016)2]

Purpose, scope and membership

The concept of a nuclear data request list has a long history in applied nuclear science. The concept is that if requests from applied users of data are collected in a convenient location, it should provide a stimulus to measurers, modellers, and evaluators to undertake work that could lead to certain requests becoming satisfied.

A revised High Priority Request List (HPRL) for nuclear data needed for applications has been in existence under the auspices of the OECD Nuclear Energy Agency (NEA) for several years. This List provides a point of reference for nuclear data stakeholders and developers and has led to many new initiatives in nuclear data measurement, evaluation and validation. Its effectiveness in stimulating new measurements, evaluations and verification actions required to meet the expressed needs is well established.

A standing Expert Group is essential to maintain the HPRL as a point of reference in nuclear data research and development. The Expert Group will consist of at least three representatives from each data project: one from the data user, one from the evaluation and validation community and one from the experimental community. The Expert Group may have additional representatives from the IAEA Nuclear Data Section, as well as countries not represented in the above mentioned projects.

The HPRL will reflect the actions undertaken by WPEC and will help guide future activities. The Expert Group will report to WPEC.

Objectives

The Expert Group is responsible for managing the activities related to the HPRL, in particular for guaranteeing that the entries are up-to-date and well-motivated by current interests in the field of nuclear energy and other nuclear applications. The Expert Group is also responsible for stimulating follow-up to the entries and collecting the feedback provided by any of the related activities that may further the resolution of a request. The Expert Group will work mainly by electronic mail exchanges. Physical meetings will be held typically once a year.

The HPRL is organised as follows:

1. The List consists of one list with truly high priority requests, a List with general requests and a List with special purpose quantities divided in categories. This third List is an extension to the present List.
2. Stringent criteria are applied for entries on the Lists. These will be evaluated by the Expert Group that will take the final decision for adopting a request.
3. A “high priority request” is justified by quantitative sensitivity studies (or the equivalent) and sufficiently documented.
4. A “general request” is well motivated for a specific quantity on a specific nucleus and is documented, but lacks a detailed backing by a sensitivity analysis or an impact study.
5. A “special purpose request” in a well-defined category is of interest to a recognised important subfield of applied nuclear science for which it is essential to stimulate new activity. Such a request may not satisfy the criteria as in the case of points 3 and 4 above.

The request Lists will be subjected to periodic review to monitor progress and determine whether each individual request should continue to be included in these Lists.

Deliverables

- A report on the status of all requests describing completed activities and outlook.
- An up-to-date online version of the “High Priority Request List for Nuclear Data”.

ANNEX 2.3 WPEC Subgroup proposal on a "Code infrastructure to support a general nuclear database structure"

Justification: Code infrastructure to work with the new international general nuclear database structure will enable international adoption

ENDF-6 has had a long and fruitful history as the preferred format for storing and exchanging evaluated nuclear data. Together with processing codes, it plays a pivotal role between nuclear physicists and reactor physicists, allowing the exchange of data between different computer codes. The WPEC Subgroup 38 was formed to solicit feedback from international stakeholders and develop a new structure for storing nuclear data. The subgroup recognized that many decades and much effort have been invested in the ENDF format and in the infrastructure built around that format. SG38 recognized that in addition to defining a new data storage structure, it must also outline a path towards either updating existing ENDF infrastructure or creating new tools capable of using data stored in the new nuclear data structure.

With the help of much feedback from the international nuclear data community, SG38 is now nearing completion, and will produce a set of requirements and specifications documents detailing how nuclear data will be stored. The focus must now turn to updating the infrastructure that handles those data.

Particular infrastructure needs identified by SG38 as being fundamentally will necessary include:

- An Application Programming Interface (API) for reading and writing data in the new structure; and
- Checking codes to help validate new evaluations and fix problems identified during validation. These include checks for proper formatting and completeness.

Other infrastructure needs have been identified as being important to support standardization and general nuclear data structure adoption across the community:

- Standards to support checking that the physics content (e.g. conservation of energy) is sensible;
- Initial infrastructure for manipulating and processing nuclear data;
- Tools for generating new evaluations using the new structure; Visualization tools; and Tools to assist with uncertainty quantification (UQ) studies using the covariance estimates that are being expanded with recent releases of nuclear data libraries.

This supporting infrastructure will enable each data project and other stakeholders to develop tools and capabilities that use the new data structure. Many of these needs may be addressed by expanding existing infrastructure (built around the ENDF-6 format) to also handle the new nuclear data structure. We also anticipate, however, that modern programming and database practices will facilitate building a new set of tools independent of old infrastructure. Part of the role of this subgroup will be to document what tests will be required to ensure that the new infrastructure is either equal to or better than legacy infrastructure.

Here, we propose a WPEC sub-group to address these infrastructure needs. The new subgroup will emphasize development of open source tools capable of reading and writing GND-formatted data as defined by SG38. Developing these tools will not only encourage adoption of the new format but will also provide practical feedback about the GND format requirements and specifications.

Membership

Subgroup Monitor : Fausto Malvagi (CEA/JEFF)

Subgroup Coordinators: Jeremy Conlin (LANL/ENDF), Caleb Mattoon (LLNL/ENDF)

Subgroup Participants

BROND	Valentin Sinitsa (Kurchatov)
CENDL	Liu Ping (CNDC)
ENDF	Bret Beck (LLNL), David Brown (BNL), Michael Dunn (ORNL), Skip Kahler (LANL), Caleb Mattoon (LLNL), Dennis McNabb (LLNL), Morgan White (LANL), Doro Wiarda (ORNL)
JEFF	Mark Cornock (AWE), Mireille Cost-Delclaux (CEA), Wim Haeck (IRSN), Cedric Jouane (CEA), Fausto Malvagi (CEA)
JENDL	Ken-Ichi Tada (JAEA)
OTHER	Oscar Cabellos (NEA), Young Sik Cho (KAERI), Do Heon Kim (KAERI), Andrey Trkov (IAEA), Victor Zerkin (IAEA)

Definition of the project and proposed activities

We envision that this subgroup will begin working on two fronts. Task 1 will be to outline a more complete list of what infrastructure for GND has already been built, and what parts still need to be built. Task 2 will be to begin drafting a common API for data processing tools to use when accessing nuclear data in the new structure. One important benefit of this API should be to help protect codes from possible future changes to the GND structure, since only the API should be directly interacting with data files. Some progress has already been made on this: AMPX, FUDGE, and NJOY21 both have their own internal representations of nuclear data that are populated when data are read in, independent of processing. A draft conceptual design will help to inform the group as to which API routines will need to be developed. The group will then document a full API - essentially a compilation of functions that specify function names, input and output data elements, and textual description of the function's purpose. The goal, to the extent possible, is to make the API computing-language agnostic. Once the API is documented by this subgroup, our hope is that instantiations of the API will be implemented in C, C++, FORTRAN and Java independently of the subgroup and shared with the community.

This new subgroup will also provide a forum for the participants to discuss their respective code infrastructure efforts. There are a number of new data processing efforts that have been initiated internationally that can benefit from sharing progress, problems and solutions. At an October 2015 IAEA Consultants' Meeting on "The New Evaluated Nuclear Data File Processing Capabilities," it was recommended that a CRP be formed a few years from now to compare these new nuclear data processing tools against each other as a necessary step toward validating and verifying the quality of these new capabilities. Another goal of this proposed subgroup is to begin to articulate which comparisons will be most valuable, so that each code infrastructure effort can develop the necessary hooks and definitions to make these comparisons.

Time-Schedule and Deliverables

- Year 1: Identify what nuclear data infrastructure need to be developed, and develop conceptual design of an API that addresses needs of data processing codes;

- Year 2: Document API, and develop a list of tests that can be used to compare new infrastructure against older ENDF-6 based tools;
- Year 3: Develop and test API instantiations, develop and document specific tests that will be used to ensure new infrastructure is working properly.

ANNEX 2.4 WPEC long-term proposal on a "Recommended definition of a General Nuclear Database Structure"

Chair

David Brown (BNL/ENDF)

Members

Representatives of the nuclear data evaluation projects or institutions from NEA member countries
Representatives of the CENDL project (China), by invitation
Open to other non-NEA member countries on a case-by-case basis, by invitation
Representatives of the EC, by agreement
Representatives of the IAEA, by agreement

Governance Board

Up to 2 official representatives from each WPEC nuclear data evaluation project or institution will form the Governance Board. Currently these entities include ENDF, JENDL, ROSFOND/BROND, JEFF, CENDL and the IAEA. *Only NEA members have voting rights with respect to the adoption of a new recommended definition by WPEC, but the larger group serves the goal of meeting the needs of the broader community.*

Justification A long-term sub-group is needed to serve as a governance body

Context

ENDF-6 has had a long and fruitful history as the preferred format for storing and exchanging evaluated nuclear data. Together with processing codes, it plays a pivotal role between nuclear physicists and reactor physicists, allowing the exchange of data between different computer codes. Today, however, it is showing signs of age. In particular, the ENDF-6 format places unnecessary limitations on the types of reactions and the precision at which data can be stored. Some features make it more difficult to assure quality and consistency of the data. Also, each new generation of nuclear scientists and engineers must overcome a steep learning curve (having nothing to do with physics, only with how data are stored in ENDF) before they are able to use the data. These users are applying nuclear data towards solving a broad range of problems (in medical physics, global security and advanced detector designs among others) that stretch the ENDF format beyond its original design. There is a strong desire, particularly among the younger generation, to adopt software concepts and technologies that are more modern, more familiar and more broadly utilized than the 1960's-vintage ENDF format.

The WPEC Subgroup 38 was formed to solicit feedback from international stakeholders and develop a new structure for storing nuclear data (NEA/NSC/WPEC/DOC(2012)438). The subgroup recognized that many decades and much effort have been invested in the ENDF format and the tools that use it. In order to be useful, the new structure must fit into the existing 'infrastructure' for nuclear data, continuing to meet the needs of evaluators, processors and users of the data. Part of the goal of SG38 was to ensure that these needs are met, and to promote a smooth transition (likely lasting a decade) from ENDF-6 to the new structure. The subgroup also recognized that Lawrence Livermore National Laboratory (LLNL) had

developed an initial proposal for a Generalized Nuclear Data structure, GND, and the U.S. nuclear data community reviewed this structure as a possible successor to ENDF. Although the first steps had been taken toward developing and deploying a new, modern nuclear data structure to replace ENDF, it needed critical review and revision by the international nuclear data community in order to ensure that it will adequately address the needs of the different data projects.

With these needs in mind, SG38 solicited feedback from the community and developed first a vision and set of high-level requirements (NEA/NSC/WPEC/DOC(2013)441) for the new format and agreed on a set of goals for the community in the pursuit of this endeavour (NEA/NSC/WPEC/DOC(2014)450). The first order of business was the development of a thorough set of requirements, specifications, and examples, which are available at https://ndclx4.bnl.gov/gf/project/sg38/. While SG38 was originally formed to develop the structure for storing nuclear data, a few other priorities were identified while developing the requirements and project plan that would be necessary after defining the structure to make it a broadly useful and widely adopted capability. First, a long-term governance structure would need to be instantiated to ensure that the recommended definition continues to evolve to meet the needs of the international nuclear data community. That need is addressed in this proposal. Second, a set of infrastructure is required to work with the structure. The infrastructure identified as being fundamentally necessary includes the definition of an Application Programming Interface (API) for reading and writing data in the new structure, an initial set of infrastructure for plotting and processing the data, and some quality assurance standards with supporting infrastructure to help enforce those standards. A separate 3-year sub-group will be proposed to address these infrastructure needs.

Purpose, scope

The WPEC Subgroup 38 was formed to solicit feedback from international stakeholders and develop a new structure for storing nuclear data. SG38 has met its stated goal to develop a nuclear data structure definition that can meet the needs of a broad set of nuclear data users and providers. In order to take the next step, it has become necessary to establish an international governance body to endorse, promote, and maintain the new format as the future international standard for disseminating nuclear reaction databases. Ideally this group should be formed under the auspices of an international body committed to improving co-operation between nuclear data communities, particularly with respect to exchanging nuclear data. The Working Party on International Nuclear Data Evaluation Co-operation (WPEC) is clearly such an organisation. It was established by the Nuclear Science Committee (NSC) of the Nuclear Energy Agency (NEA) to promote the exchange of information on nuclear data evaluations, measurements, nuclear model calculations, validation, and related topics, and to provide a framework for co-operative activities between the participating nuclear data projects. It is for this reason, that we propose that a new WPEC long-term subgroup become the stewards of a new international definition for a modern nuclear database structure. The subgroup will report to WPEC.

Goals, activities and deliverables for the governance body

As with all major undertakings, the participants of the community that have worked so hard to get this recommended definition in place are motivated not solely by professional recognition or by the practical value of establishing a modern capability to replace an existing on (ENDF-6). The participants have other worthy goals beyond the main motivations of making it easier for new users, as well as current users, to contribute to the community and to encourage better quality assurance and documentation practices. It is hoped, for example, that the structure defined is general and useful enough that it could also be used to organize nuclear structure data, experimental data, and other nuclear data products. Other goals include the development of better open source infrastructure to manipulate, search, plot, process, translate and check nuclear data and the development of new nuclear data products heretofore not possible.

These issues have led the community to consider that the long-term governance body must not only be the stewards of a nuclear data format structure, but also the shepherds for new infrastructure and promoters for better evaluation practices. In that sense, the community hopes the governance body will become a forum for many discussions on these issues. We envision that the need and opportunity will arise for the formation of WPEC sub-groups to work on specific format structure or data infrastructure. These sub-groups will report directly to WPEC, but the results from these groups will be taken under consideration for adoption under the aegis of this long-term governance group.

A challenge for any international effort is to provide an effective platform for collaboration, e.g. the tools, websites, repositories, meetings and other forums. In particular, given that travel is expensive, it is desirable that meetings can be attended virtually with teleconferencing and videoconferencing capabilities, with considering enough discussion can be done.

In a practical sense, the governance must perform some specific actions associated with deliverables clearly identified. While ensuring that the recommended definition meets the needs of major international nuclear data communities, this governance body must:

1. Approve and release the initial version
    - Deliverable 1: Documentation of the initial version
2. Provide a productive environment to modify and extend the recommended definition
    - Deliverable 2: Collaborative platform and practices to maintain and discuss the recommended definition
    - Deliverable 3: Workshop to train evaluators and other members, especially users, of the nuclear data community the new structure.
3. In close collaboration with the short-term subgroup on infrastructure ensure that important and useful tools for using the new recommended definition are developed and maintained, and
4. Release new versions with appropriate documentation as necessary, without overburdening stakeholders

ANNEX 3

Subgroups Status

Short-term subgroups

	Topic	Co-ordinator	Status in May 2015
27	Prompt photon production from fission products	R. Jacqmin, JEFF	Closed; final report to be issued by the end of 2015
28	Processing of covariance data	M. Dunn, ENDF	Closed; final report to be issued by the end of 2015
35	Scattering angular distribution in the fast energy range	T. Kawano, ENDF	Closed; final report to be issued by the end of 2015
36	Reporting and usage of experimental data for evaluation in the resolved resonance region	P. Schillebeeckx, JEFF	Closed; final report to be issued by the end of 2015
37	Improved fission product yield evaluation methodologies	R.W. Mills, JEFF	Ongoing; established in 2012 with effective start in 2013. Closed in 2017
38	Beyond the ENDF format: A modern nuclear database structure	D. McNabb, ENDF	Ongoing; established and started in 2012. Closed in 2017
39	Methods and approaches to provide feedback from nuclear and covariance data adjustment for improvement of nuclear data files	G. Palmiotti, ENDF M. Salvatores, JEFF	Ongoing; established and started in 2012. Closed in 2017
40	CIELO pilot project	M. Chadwick, ENDF	Ongoing; established and started in 2014. Closed in 2017
41	Improving nuclear data accuracy of 241Am and 237Np capture cross-sections	H. Harada, JENDL	Ongoing; established and started in 2015. Closed in 2017
42	Thermal Scattering Kernel S(α,β): Measurement, Evaluation and Application	S. Kahler, ENDF	Ongoing; established and started in 2016

Long-term subgroups

C	High Priority Request List	A. Plompen, JEFF	Ongoing, approved new mandate until 2018