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International Atomic Energy Agency

**INDC(NDS)-0856**

**Distr. LP,G**

# **INDC International Nuclear Data Committee**

## **Summary Report of the Consultants' Meeting on Model Code Output & Application nuclear Data Form Structure**

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June 2022

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Printed by the IAEA in Austria

June 2022

**Summary Report of the Consultants' Meeting on  
Model Code Output & Application nuclear Data Form Structure**

Authors

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**Abstract**

The purpose of the event is to assess the actual capabilities, successfully deployed methods, tools and protocols, future needs in terms of model code output and application nuclear data form structure with the aim of testing/prototyping/developing and deploying cutting-edge nuclear data form structure to support high-fidelity Multiphysics simulation efforts. A partnership between fundamental sciences and applications, along the lines of PREPRO, CRECTJ6, FUDGE, TAGNDS, TARES, DeCE, TEFAL, GIDI, MCGIDI.

June 2022



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## Objectives

The purpose of the event is to assess the actual capabilities, successfully deployed methods, tools and protocols, future needs in terms of model code output and application nuclear data form structure with the aim of testing/prototyping/developing and deploying cutting-edge nuclear data form structure to support high-fidelity multiphysics simulation efforts. A partnership between fundamental sciences and applications, along the lines of PREPRO, CRECTJ6, FUDGE, TAGNDS, TARES, DeCE, TEFAL, GIDI, MCGIDI

**Applications** multi-physics, criticality, transport-shielding, reactor design, fuel-cycle, experiment analysis, activation-transmutation-depletion-breeding inventory, materials, space, earth, and life sciences

## Introduction

Nuclear observables and data forms are at the foundations of most nuclear programs. IAEA's member countries traditional efforts in research, development and technologies have been in support of each member's needs; they differ. Those efforts have concentrated on answering the needs of a few major applications one at a time: energy, reactor, accelerator physics, medical, etc. However, the scenarios are shifting in support of new experiment analysis, old experiment re-analysis materials, earth, and life sciences with extended incident & outgoing particles energy range, cross-country, -continent collaboration on new technologies. Although the field is considered as established, not every corner or stone of the nuclear landscape has been properly or even entirely mapped.

The intention is to probe the lesser actinides, the materials, the exotic channels. Investigate the short lived and go deeper than the neutron map only. Improve/extend the emitted missing angular distribution and energy spectra. Scouts the nuclear landscape for gems and extends the incident particles and their energy ranges. Also populates the missing quantities. Apply theoretical-practical sciences to support all needs, a partnership between fundamental sciences and applications needs in quick steps.

## Talks summaries

### **FUDGE and GNDS: an overview; Dr CALEB, Mattoon (LLNL)**

FUDGE and GNDS are the center of a new focus on nuclear data at LLNL. The GNDS format offers much greater flexibility and extensibility for storing data than either ENDF or the legacy LLNL format ENDL. FUDGE, LLNL's nuclear data management code, has been developed alongside GNDS and fully supports the new format. FUDGE capabilities include translating data to and from GNDS, checking both the formatting and physics content of GNDS evaluations, processing data for use in transport applications, and visualization. Recent development in FUDGE has focused on improving the pipeline for generating new GNDS-formatted evaluations as well as on expanding processing capabilities especially in the thermal and unresolved regions.

### **CBZ: the deterministic reactor physics code system Content; Dr CHIBA , Go (Hokkaido University)**

Nowadays, several highly qualified and easy-to-use continuous-energy Monte Carlo particle transport codes have been developed, and numerical simulations related to the nuclear reactor physics and the radiation shielding are conducted with them. However, the deterministic method is still important since it is free from statistical uncertainties and simulation results can be obtained faster with it than with the Monte Carlo codes. In the deterministic methods, energy discretization is required, so energy-averaged (multi-group) nuclear data are essential.

A deterministic reactor physics code system CBZ has been being developed at Hokkaido University for the research work in the field of nuclear reactor physics, and now it is utilized for various applications in the nuclear reactor physics such as fast reactor core design work. The application field of CBZ is now being enlarged to the temperature profile calculations at the nuclear waste repository site and the optimization study of the neutron source for medical use.

With CBZ, various types of numerical simulations can be conducted such as the nuclear reactor kinetics calculations with the explicit fission product model, nuclear fuel depletion calculations with the detailed or compressed depletion chain, sensitivity and uncertainty analyses on nuclear fuel burnup characteristics with the help of the generalized perturbation theory, and so on. For these simulations, relevant nuclear data such as reaction cross

sections for neutron and photon, photon generation data, decay and fission yield data for fuel burnup and delayed neutron emission, and the covariance data.



As mentioned above, CBZ is based on the deterministic method, so the multi-group nuclear data are essential. The NJOY99 and NJOY2016 have been used to generate multi-group data so far, but now the new codes FRENDY and FRENDY/MG have been adopted to the multi-group data generation system in CBZ.

### **Nuclear Data Needs for High-Fidelity Reactor Multiphysics Calculations; Dr GRIESHEIMER, David (NNL)**

Accurate nuclear data is essential for high-fidelity simulations involving coupled physics, such as in a nuclear reactor. In this talk I will review the various Multiphysics effects in nuclear reactor analysis and shielding calculations and provide insight into the current limitations of nuclear data for performing these types of calculations. These limitations point to a need for further improvements in nuclear data, including a need for: consistent energy release/deposition data, accurate secondary emission yields and spectra for all significant reactions, accurate cross sections for non- standard reactions (such as photonuclear,  $(\alpha,n)$  and damage reactions), efficient and compact data representations for complex reactions, energy dependent fission product yield data, and improved qualification for all data. These observations are supported by a series of case studies in reactor analysis and nuclear shielding that highlight the limitations of contemporary nuclear data evaluations for realistic calculations.

### **DeCE: the ENDF-6 data interface and nuclear data evaluation assist code; Dr KAWANO, Toshihiko (LANL)**

We presented an overview of two computer programs at Los Alamos National Laboratory, CoH3 the coupled-channels Hauser-Feshbach for reaction cross section calculation code, and DeCE the post-processing of the code output. Several notable features in CoH3, such as the exclusive reaction chain algorithm and the angular distributions for secondary particles, are briefly explained. The computer program DeCE is open-source software to assist in producing evaluated nuclear data files. DeCE manipulates a provided evaluated nuclear data file interactively, then creates a new file in an ENDF-6 legitimate format. DeCE also imports numerical data given in an external file, such as model calculation outputs, to convert them into the ENDF-6 formatted file. The code includes two C++ libraries, ENDFLIB and ENDFIO, which fulfill a demand for an easy interface between a modern computer programming technique and the inflexible ENDF-6 format. The capabilities of DeCE were demonstrated by showing several examples including ENDF data extraction, fixing the header information in an existing ENDF file, arithmetic operation of different cross section data, producing pointwise and grouped cross section data from resonance parameters, etc. The details of DeCE was

published in <https://doi.org/10.1080/00223131.2019.1637797> and the source code is available at <https://github.com/toshihikokawano/DeCE>

### **Recent Needs from Transport Codes; OGAWA, Tatsuhiko (JAEA)**

In the field of general-purpose transport code, one of the hot topics is the global evaluation of cross sections for track-structure calculation. Charged particles travelling in matter produce secondary electrons, so-called delta-rays. The simulation of production and transport of delta-rays typically below 1 keV is called track-structure calculation. Track-structure calculation is used as a promising tool to understand the effect of radiation to cells, detector materials, semiconductor devices, etc. from a new perspective.

Track structure calculation requires delta-ray production and transport cross sections but up to now, no cross-section data libraries are available even though there are some 10 to some 100 publications on cross section measurement and cross section fitting formulae. On the other hand, delta-ray cross section data and nuclear cross section data have lots of things in common. For example, there are nuclear/atomic structure behind the cross-section data, cross sections are corrected considering the chemical forms of the target.

Based on the above, it is pointed out that the tools and formats developed for nuclear reactions cross sections can be useful for compiling track-structure calculation cross section data library with taking advantage of their similarities.

### **Options for producing OpenMC HDF-5 cross section files; Dr SHIMWELL, Jonathan (UKAEA)**

The presentation covered methods of generating and downloading hdf-5 cross section files for use in OpenMC. The methods covered were: downloading of compressed libraries from <http://openmc.org>, automatically downloading and processing ACE / ENDF files using scripts from the <https://github.com/openmc-dev/data> repository and just in time down-loading of specific isotopes using the openmc-data-downloader package. The openmc-data-downloader package relies on the <http://github.com/openmc-data-storage> GitHub organisation to serve as a h5 file distribution point. Traditionally hundreds of ACE or ENDF files are compressed and distributed as a complete library which is typically several Gigabytes in size. This repository breaks the mould by distributing separate hdf-5 files which already benefit from a smaller file size compared to the ASCII files and are typically

a few Megabytes in size. The <http://github.com/openmc-data-storage> GitHub organisation makes use of repository templating, containerisation (Docker) and GitHub Actions Continuous Integration (CI) to quickly build up a collection of processed libraries of hdf-5 files. Once processed, separate URL endpoints are generated for every isotope / every hdf-5 file in the library. A database of all the available URL endpoints has been made within a Python package called openmc-data- downloader which is distributed on PyPi as a pip installable package. The package is able to accept user arguments specifying the nuclear data library, elements, isotopes, openmc material or materials.xml files which are used to find the isotopes to download. These arguments can be specified via the command line or via a Python API. Once accepted by the Python package the user arguments are used to filter the internal database (Pandas data frame) and produce a list of isotopes to download. If multiple libraries are specified by the user they will be searched preferentially until the required isotopes are found. The list of isotopes is then downloaded (unless they already exist) and the OPENMC CROSS SECTION environmental variable is (optionally) set to the custom cross sections.xml produced. The Python package addresses one of the most common user difficulties reported on the forum and aims to make the process of downloading the required nuclear data simpler for users. CI systems that run OpenMC simulations can also benefit from this minimal cross section distribution as it reduces the download burden from several Gigabytes to potentially just a few Megabytes and reducing the time to simulation.

### **Status of GNDS support in AMPX/SAMMY and future outlook; Dr WIARDA, Dorothea (ORNL)**

SAMMY is the Oak-Ridge R-Matrix code for evaluations and AMPX is the processing code to generate data libraries for SCALE.

In AMPX we have C++ in-memory classes for all data read from ENDF. These classes are filled at the beginning of a calculation. These classes support ENDF-formatted or GNDS formatted files (the code for GNDS is in the final stages of review). Any processing in AMPX only accesses the in-memory classes. We plan to extend this to SAMMY.

GNDS reading has several layers:

- An Element, Attribute and Document classes read on-disk data, plus a class that handles access to external files such as linked covariance data. This will facilitate reading not only XML formatted GNDS files but also future HDF5 versions without changes in the other layers.
- The GNDS layer consists of classes that are automatically generated from the JSON files defining the GNDS specification.

- The final layer takes the data from the lower two layers and fills our AMPX in-memory classes. This is needed to have easy access to the particle database, to select the style and to convert to AMPX units.
- Our in-memory classes are the API from which all further access occurs.

SAMMY is still a predominately F77 based code, but we have made progress in our modernization effort. Throughout the code we use the AMPX in-memory R-Matrix class, as well as the covariance class, which allowed us to remove many scratch files. We plan to make the code more modular, and to share resonance reconstruction and temperature broadening implementations with AMPX.

We intend to modernize the user input and output for SAMMY and reuse GNDS elements in order to share the details of an evaluations more easily with the community. For that to work, a definition for normalization, sample parameters and facility resolution functions need to be agreed upon. This will allow to save the covariance matrix, not only for the resonance parameters, but also for the normalization, sample parameters, etc. In order to preserve the positive definiteness of the matrix, we want to explore binary formats for the GNDS file, which LLNL has already started to do.

SAMMY is available from <https://code.ornl.gov/RNSD/SAMMY> , however, SCALE 6.3 beta 9 and up is needed to compile it. We are in the process of making the part of SCALE needed to compile SAMMY available in an open-source repository. This will include our GNDS and ENDF reading and writing classes.

## **Handling the evaluated nuclear data format and ACE format in FRENDY; Dr TADA, Kenichi (JAEA)**

JAEA stated developing a new nuclear data processing system FRENDY (From Evaluated Nuclear Data library to any application) in 2013. FRENDY Version 1, which generates ACE file for the continuous energy Monte Carlo calculation codes, was released in 2019. FRENDY is an open-source software under 2-clause BSD license, and everyone can download the source files, manual, presentations, and exercise materials from following website: [https://rpg.jaea.go.jp/main/en/program\\_frendy/](https://rpg.jaea.go.jp/main/en/program_frendy/)

FRENDY has original format of the nuclear data, i.e., NuclearDataObject class, for efficient management of nuclear data. Though the current version of FRENDY can only treat ENDF-6 format, it can easily handle the other nuclear data format, e.g., GNDS format, when we implement the reader, writer, and converter classes. We are now planning to use GIDI plus of LLNL as the reader and writer classes to handle GNDS format.

Recently, JAEA and Nagoya University are collaborating to develop the multi-group cross section file module FRENDY/MG. FRENDY/MG generates a multi-group cross section file from an ACE file. Since many institutes generate and release the ACE file, user can generate multi-group cross section file using these official ACE files. FRENDY/MG focuses on the neutron cross section generation. This module can treat fast continuous and thermal scattering law data. FRENDY/MG will be released as a function of FRENDY Version 2 in the near future.

FRENDY also prepares tools to handle the ENDF/PENDF and the ACE files. The XS plotting tool for the ENDF-6 and the ACE files are contained in the exercise materials. These tools output one-dimensional table data. User has to use the graphing utility, e.g., Excel or GNUPLOT, to plot the graph.

FRENDY has the ENDF/PENDF file modification tool to estimate the impact of the nuclear data libraries difference on the neutronics calculation. This tool removes, adds, and exchanges the specified MF/MT data. Note that this modification tool does not check the modified file.

The ACE file perturbation tool is implemented for the random sampling. The perturbation factor calculation tool using the covariance matrix is also prepared to generate the input file of the ACE file perturbation tool. These tools are available for the sensitivity analysis and the uncertainty quantification using a continuous energy Monte Carlo calculation code.

### **GNDS, ENDF-6, HENDF, PENDF, GENDF, ANISO, ACE data forms and format; Dr SUBLET, Jean-Christophe (IAEA)**

The nuclear data research and development field, like many others obey specific lexical semantics. There is some importance in clearly differentiating between data format, form and formalism: Generalised Nuclear Data Structure GNDS and Evaluated Nuclear Data Format ENDF-6 are structure and format definition; hybrid evaluated nuclear data file hendf, pointwise-endf, groupwise-endf, a compact endf ace, probability table pt, aniso, probability distribution function pdf, cumulative cdf and tabulated function tf are acronyms forms descriptor while Multi-Level-Breit-Wigner, Reich-Moore, R-Matrix Limited, Blatt and Biedenharn, Kalbach-Mann, Froehner or Watt defines some of the formalisms available. Pre-processing steps allow to convert the ENDF-6, GNDS format into simple forms that can be interpreted while fully fledged processing steps processes the ENDF-6, GNDS data into complex forms useful for applications: particles transport, reactor analysis codes, etc. For decades evaluator have relied on the capability, understandability, evolution of a handful of processing codes to feed in all the applications with little regards to concept such as efficient interfacing or connection. Evaluated files are just a commencement, although they are seen as an end to an entire community. Processed nuclear data forms are numerous, rich, abundant, diverse.

Some are observable other are not, all have specific importance for at least one application although necessary to all. Processing enhances, enriches, deepens the evaluated nuclear data forms, however many of its most low level, but most physical procedures could be handled directly during the evaluation stages and stored without the need of further treating. A more direct partnership between fundamental sciences and applications in support of the simulation efforts.

### **Resonance's form and format: TARES inside; Dr ROCHMAN, Dimitri (PSI)**

The TARES code is performing formatting of resonance parameters and uncertainties into ENDF-6 formatted files. The main goal being to complement TALYS in the resonance range using measured and compiled resonance parameters, but also to generate statistical resonances when needed. Automation is at the central place of the global approach, so that TARES and TALYS can be applied to more than 2800 isotopes for the TENDL library.

With automation comes default values, rules, portability and reproducibility. It is therefore crucial that the "full environment" (input database, as well as outputs) can be standardised and can be driven by scripts or other codes. Further efforts should be directed towards such goals, not only for this code, but also for the full evaluation "pipeline".

### **Output of the CCONE code and creation of ENDF-6 format file; Dr IWAMOTO, Osamu (JAEA)**

The CCONE code system was developed for the evaluation of nuclear data for JENDL by integrating several nuclear models such as optical model, exciton model and statistical model. The CCONE includes programs of CCSM and CCFM for calculation with the nuclear models and creation of the ENDF-6 formatted files, respectively. Results of the CCSM calculation are written into a single file in the XML format. The file contains various information such as input data, calculated cross sections and emission spectra, properties of nucleus, and so on. CCFM is a Ruby script to transform the output of CCSM to the ENDF-6 format file. CCFM uses an XML library that make ease to access the data needed for ENDF-6 format by XML Path Language. A C++ class library for manipulation of ENDF-6 format file was developed for the replacement of CRECTJ6 that is written in FORTRAN-77 language and has some limitation to treat ENDF-6 files from CCFM. The class library has capabilities to read and write the ENDF-6 format files, to make arithmetic operation of the TAB1 record, etc. The interface to the library for Ruby is prepared and CCFM utilizes it to increase consistency between partial and total cross sections and completeness in ENDF-6 format.

## **TENDL: Completeness and limitations of the ENDF-6 format; Dr KONING, Arjan**

TENDL is a general-purpose nuclear data library for all particles, all nuclides and all energies.

The software system built around TALYS, called T6, can be regarded as a prototype nuclear data pipeline in which the entire chain from basic nuclear data to applications is automated. Thanks to the capabilities of the resonance code TARES and the nuclear reaction model code TALYS for the fast energy range, virtually all possible storage options available in the ENDF-6 format have been used to come to a nuclear data library that is as complete as possible.

While aiming for that completeness, shortcomings of the ENDF-6 format came to light. This is particularly acute for covariance data as the ENDF-6 format does not allow certain classes of nuclear data to be accompanied with covariances. Important examples are MF36 for double-differential spectra and gamma-ray branching ratios, MF38 for fission yield and decay data, and MF42-45 for a full representation of gamma covariance data. All these further extensions of ENDF-6 do not, and probably will never, exist.

One way out is uncertainty quantification and propagation via Total Monte Carlo, but for the nuclear data evaluation process needs to be entirely reproducible. Therefore, it is argued that both fundamental nuclear data to build data libraries and applied nuclear data to validate nuclear data libraries become available via flexible API's. Some software to accomplish this has been made available at <http://nds.iaea.org/talys>

## **Tools using GNDS for the inter-conversion of inputs and outputs for R-matrix codes; Dr THOMPSON, Ian (LLNL)**

The R-matrix method of Lane and Thomas is the standard procedure for modelling resonances at low energies, to determine widths and angular distributions needed for nuclear evaluations. Many different codes have been written, all with different input and output file formats. To ensure that results can be replicated, I have written a python code FERDINAND using FUDGE to read & write ENDF, GNDS standard formats, read AMUR, AZURE, EDA, FRESCO and RAC formats, and write AZURE, EDA, FRESCO, HYRMA and latex formats. This led to our verification paper Thompson et al, Eur. Phys. J. A (2019) 55: 22. FERDINAND also translates between regular and the Brune basis, converts formal widths to reduced-width amplitudes, and copies forward data normalization factors and covariance matrices resulting from a fit.

Because of the increasing need for gamma production information, R-matrix codes are being extended to include primary and secondary gammas and predict the angular distributions for both of kinds. More excited states of residual nuclei need to be included in the fits, since these give directly

many of the secondary gamma decays. These place computational demands on the codes, and I am developing an GPU code RFLOW for fitting, using Google's Tensorflow framework.

There is also a need to go higher-energy states in the compound nucleus. This will require theory developments to ensure smooth transitions from unresolved and/or overlapping resonances in an R-matrix code to Hauser-Feshbach predictions that are based on transmission coefficients derived from optical potentials. A good connection between these two methods should be possible because the Hauser-Feshbach method may be derived as an approximation to R-matrix resonance descriptions.

### **From nuclear model parameters to neutronic simulation with the CONRAD and LAST codes; Dr NOGUERE, Gilles (CEA)**

The Conrad tools box encompasses R-Matrix formalism, optical and statistical models to support CEA nuclear evaluation efforts. CINEL model is used when the thermal scattering law play an important role. It uniquely combines ESTIMA and SPRT methods when exploring the unresolved resonance region of a nuclei and rely on the most advanced model when fission is concerned: (n, $\gamma$ f) reaction, Class-II states, Pf(E), etc. The evaluation processes and results are immediately and directly coupled with the Library and Stochastic Transport (LAST) simulation code capable of scoring, probing the evaluated nuclear data files through Keff simulation. This coupling allows on-the fly sensitivity calculation, perturbation theory to further probe the newly evaluated data when direct comparison with authoritative NPP measurements have been made, and this as much as at the Beginning of Life of a plant or during its most advanced high burnup cycles. Conrad and LAST forms the backbone of a strong partnership between fundamental sciences and reactor application to support the present and future French simulations efforts on NPP.

### **ENDFtk: A Robust C++/Python API for Reading/Writing ENDF-formatted Data; HAECK, Wim (LANL)**

The current production version of NJOY consists of a number of monolithic processing modules that each do specific work. For example: RECONR does resonance reconstruction and cross section linearization, BROADR does Doppler broadening on those cross sections, etc. This monolithic structure of NJOY is most useful when processing full evaluations into application libraries. However, for some fringe applications and a lot of day-to-day work where nuclear data users have specific questions (e.g., what is the cross-section value at this energy), the monolithic structure of NJOY does not allow a user to get to that answer quickly or efficiently. In addition, some of the



intermediate results produced during processing are not available to a user. An example here would be to obtain the elements of the R-matrix or T-matrix during resonance reconstruction.

By moving away from the module structure of legacy NJOY to a component-based toolkit for a modern NJOY, we can allow for faster deployment of tools and integration in other tools. Providing both a C++ and python interface at the same time will also help in deploying these tools more quickly. As an example of this approach, the ENDFtk toolkit and has been presented. ENDFtk is our primary toolkit for reading, writing and creating ENDF formatted data. In its current state, it is probably the most complete format component we have available. It is also the first NJOY component to have a fully functional python interface.

The current available version of ENDFtk provides full C++ and Python coverage for MF1 through MF7 and MF12 through MF13. Only the radioactive decay data from MF8 MT457 is supported in ENDFtk v0.2.0. In the past, NJOY has also used a number of unofficial extensions to the ENDF format to pass around information between modules. ENDFtk also supports some of these extensions: the MF2 MT152 section (for cross section data as a function of dilution in the unresolved resonance region) and an extension of the secondary particle distribution types in MF6 for use in the THERMR module.

Similar approaches will be adopted for the other format components for use in NJOY (primarily GNDStk and ACETk) and the processing components (for example resonance reconstruction and a functional interpretation library that allows for linearization, integration, and differentiation of nuclear data).

## Recommendations

Evaluated file is just a commencement, although it is seen as an end by an entire community.

It is necessary to build from the existent, when possible, enhances the data forms, makes them worthwhile, complete, finish the evaluations, libraries, complement, constrain with theory when needed as the experimental databases do not cover for every aspect.

Processed nuclear data forms are numerous, rich, abundant, diverse. Some are observable, other not, all have a specific importance, differentially and subtly influence the simulation processes. The processing steps enhances, enriches, deepens the evaluated nuclear data forms, their usefulness for the diver applications that need them. The processing trails and their landmarks deliver to all user's applications while the law of physics allows many verification processes to take place during processing.

There is a clear need to exemplify, to test-prototype-develop then deploy-share cutting-edge nuclear data form and structure to support high-fidelity multiphysics simulation efforts.

The work is a partnership between fundamental sciences and applications where both communities need to better communicates.

## References

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PREPRO, <https://www-nds.iaea.org/public/endl/prepro/>

SAMMY, <https://code.ornl.gov/RNSD/SAMMY>

FUDGE, <https://github.com/LLNL/fudge>

GNDS, [https://www.oecd-neo.org/jcms/pl\\_39689/specifications-for-the-generalised-nuclear-database-structure-gnds?details=true](https://www.oecd-neo.org/jcms/pl_39689/specifications-for-the-generalised-nuclear-database-structure-gnds?details=true)

TALYS, <https://www-nds.iaea.org/talys/>

OpenMC, <http://openmc.org>

DeCE, <https://github.com/toshihikokawano/DeCE>



## **Consultancy Meeting on Model Code Output & Application nuclear Data Form Structure**

March 15 – 17th, 2021, IAEA Headquarter, Vienna, Austria

### **Virtual Event - AnDFS**

#### **Agenda**

14:00 – 18:00 CET

**Monday March 15<sup>th</sup>, Virtual Room**

14:00 Welcoming address – Arjan Koning, SH-NDS

Election of chairman and rapporteur Adoption of agenda, administrative matters

Introduction, Scope of the CM - J.-Ch. Sublet, UH-NDSU

14:10 J.-Ch. Sublet (IAEA) “AnDFS white paper”

14:30 T. Kawano (LANL) “DeCe: the ENDF-6 data interface and nuclear evaluation assist code”

15:00 O. Iwamoto (JAEA) “output of the CCONE code and creation of ENDF-6 format file”

15:30 D. Wiarda (ORNL) “ Status of GNDS support in AMPX/SAMMY and future outlook”

16:00

16:30 K. Tada (JAEA) “Handling the evaluated data format and ACE format in FRENZY”

17:00

17:30 D. Rochman (PSI) “Resonance’s form and format: TARES Inside”

18:00 End of Day One

**Tuesday March 16<sup>th</sup>, Virtual Room**

14:00

14:30

15:00 J.-Ch. Sublet (IAEA) "GNDS, ENDF, HENDF, PENDF, GENDF, ANISO, ACE data forms and format"

15:30 A. Koning (IAEA) "TENDL: completeness and limitations of the ENDF-6 format"

16:00

16:30 P. Romano (ANL) "OpenMC's Nuclear Data Pipeline and HDF5 Format"

17:00

18:00 End of Day two

**Wednesday March 17<sup>th</sup>, Virtual Room**

14:00 I. Thompson (LLNL) "Tools using GNDS for the inter-conversion of inputs and outputs for R-matrix codes"

14:30

15:00

15:30

16:00 Discussions, Resume

17:00

17:30 Conclusions

18:00 Close of meeting





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