INDC Proposal

Nuclear Data form and Observable for the safe Monitoring, Handling and Disposal of nuclear fuels and irradiated material from Pile, Experiment, Facility and Nuclear Power plant

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Background

- It is foreseen that during the next decades a significant number of nuclear power plant NPP, pile and equipment will have reached their end of life
- From a 2020 World inventory of circa 840 piles and research reactors, 226 still operational, 450 operational nuclear power plant generating electricity, 44 having been loaded with MOX fuel since the 70's, numerous research, industrial and medical facilities
- One notices that quite a few have already reached or are close to their end of life, have been closed while inevitably more will also reach those stages in the next decades

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Background

- Existing plants, new conceptual designs need scouting the nuclear lanscapes for operational efficiency, optimisation, safety or security gains
- New concepts need robust simulation based on exhaustive, complete nuclear data as experiments are scare outside the traditional enveloppe
- Exhaustive, robust simulation of irradiated fuels, plant interns, irradiared structures are needed beyond the sole timescales of operation and wet storage

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CM on nuclear data form and observable for the safe Monitoring, Handling and Disposal of nuclear fuels and irradiated material from pile, experiment, facility and nuclear power plant

2-4 November 2020, IAEA, Vienna

The purpose of the Consultancy Meeting on nuclear data form and observable for the safe Monitoring, characterisation, Dismantling, Decommissioning and Disposal of nuclear fuel and irradiated material from nuclear power plant, pile, experiment and facility is to assess members needs in terms of research, compilation and assembling of the specific nuclear data forms and observables databases needed for robust nominal and conceptual simulations of time dependant nuclear inventory, radiological characterisation and source terms for the fission, fusion, accelerator, life, earth, research sciences applications.

Agenda

The agenda is available from here.

An instant of the virtual meeting https://www-nds.iaea.org/index-meeting-crp/CM-McDDD/

Summary Report

The summary report INDC(NDS)-0822 is available.

Presentations

#	Author	Title	Link
1	J.-Ch. Sublet	McDDD white paper	PDF
2	D. Rochman	Nuclear data needs for Spent Fuel Characterization: a PSI outlook	PDF
3	Y.O. Lee	Analysis and Validation of SNF Characterization via Ultra-Fine Grid Core Tracking with Improved Nuclear Data Movie	PDF
4	M. DeHart	Simulation Needs for Advanced Reactor Technologies	PDF
5	B. Forget	Nuclear Data Issues for High Fidelity, High Performance Reactor Modelling and Simulation	PDF
6	L. Leal	IRSN methods and tools for data needs identification	PDF
7	O. Iwamoto	Recent development of nuclear data libraries for nuclear decommissioning and transmutation in the JENDL project	PDF
8	J.-Ch. Sublet	The nuclear data forms and observables of the lesser Gods	PDF
9	O. Cabellos	Nuclear Data Needs for characterization of nuclear fuel and irradiated materials	PDF
10	M. DeHart	Validation Challenges in Multiphysics Simulations of Advanced Reactors	PDF
11	M. Gilbert	Importance of nuclear data for fusion reactor predictions of material activity and waste	PDF
12	K. Tanaka	Needs for Nuclear data - Aiming to improve radiological characterization reliability for decommissioning, and disposal of radioactive waste from nuclear power plants	PDF
13	G. Bailey	Towards beta-neutrino spectra from complex nuclear inventories	PDF
14	A. Ferrari	Challenges in shielding design at accelerator systems in special environments	PDF
15	G. Ilas	Spent Nuclear Fuel Applications: ORNL Validation Experience	PDF
16	A. Sjöland	Perspectives and needs for nuclear data activities with a focus on spent nuclear fuel characterization	PDF
17	C. Mattoon	LLNL Nuclear Data Needs and GNDS	PDF
18	B. Grove	Nuclear M&S Tools and Applications at ORNL and related Nuclear Data perspectives	PDF
19	O. Köberl	A Utility perspective Beznau NPP	PDF

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Purposes

- To comprehend the needs for data forms and observables, services and capabilities in the operational and research areas important for time-dependent source terms simulations in support for the safe Monitoring, Handling and Disposal (even temporary) of irradiated materials and fuels, been existent or conceptual
- The simulations scheme and protocols involved rely heavily, depend on both comprehensive, all-embracing nuclear reactions, emitted particles, residuals spectra and decays data in unison

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Aims

- to research, compile and assemble, deliver and deploy the data forms and observables needed for robust nominal or conceptual simulations of nuclear inventory and source terms for all applications

- From the backend of the fuel cycle to millennia when fission is concerned, but also able to provide for the specific need of accelerator, fusion, space and non-energy life and earth sciences applications

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Intentions

- One imperative will be to streamline, automatize the evaluation, processing and verifications of the multiphase protocols capable of delivering the practical data forms needed while providing uncertainty quantification and propagation methodology UQM
- Such undertakings would also benefit for activities related to novel reactor concepts and fuel cycles research, development and demonstration by filling the gaps, completing the nuclear forms landscape beyond and above the traditional envelope

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Limited regional tentative, to build upon

- JENDL LLFP Transmutation Cross Section File - JENDL/ImPACT- **2018** - 163 targets

  https://wwwndc.jaea.go.jp/ftpnd/jendl/jendl-impact-2018.html
- JENDL Activation Cross Section File for Nuclear Decommissioning - JENDL/AD-**2017** - 312 targets

  https://wwwndc.jaea.go.jp/ftpnd/jendl/jendl-ad-2017.html
- The European Activation File projects (**2010**) – 816 targets

  https://www.oecd-nea.org/dbforms/data/eva/evatapes/eaf_2010/
- UK Decay Data 2012 - general purpose decay data

  https://fispact.ukaea.uk/nuclear-data/downloads/

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Deliverables

- The end-products fully integrate the nuclear data forms and observables (all fuels, materials) needed beyond the normal and safe operational NPP, piles, conceptual design needs, for in depth activation, transmutation, fuel burnup, shielding, materials decay doses and heat, hazard indices simulations
- Actual and conceptual novel concepts, accelerator, fusion, space and non-energy life & earth sciences applications fully covered by the high to low energy incident particle ranges and for the timescale from second after operation to millennia

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Deliverables

- A specific goal is to achieve completeness in covering the nuclear data lanscape rather than partiality without loosing the gains: precision, robustness secured over decades in mostly but not only fission applications
  - Z=1-100, Hydrogen to Fermium, stable but also radioactive targets
  - Including isomeric states, target & daughter
  - Gamma, proton and neutron incident up to 200 MeV
  - Cross section, residual and emitted particle spectra,
  - Decay data for all residuals products

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Strategy

- 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
- However the scenarios are shifting in support of more cross-country, -continent collaborations on new technologies and waste standards (for acceptability) while regulations and licensing protocols now need to account for export markets (for critical mass, series effects, costs optimization)

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Operational implementation

- Leadership NAPC/NDS with involvement, interest, collaboration with NAPC/PHY, NENP/NPTD, NENP/MFCM, NE-NEFW
- Interested IAEA's members countries and institutions: UK, Japan, Sweden-Norway-Finland, China, Switzerland, USA, Spain, France, Germany, Canada, etc. All countries suceptible to engage in NDO-MHD activities from Nuclear Power, Nuclear Sciences or otherwise
- Timelines: 2021-2024

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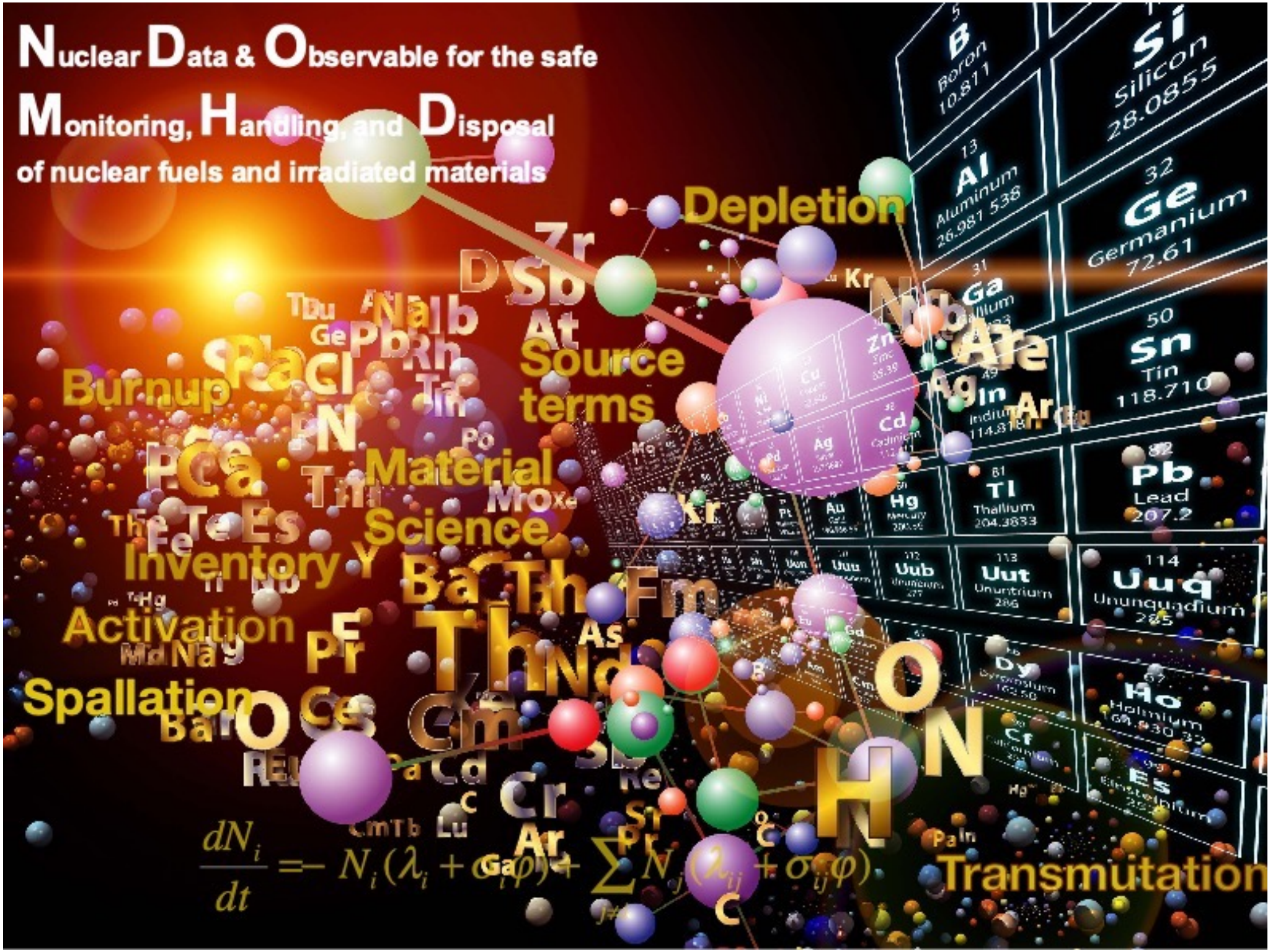
Nuclear Data & Observable for the safe
Monitoring, Handling, and Disposal
of nuclear fuels and irradiated materials
Depletion
Source terms
Material
Science
Inventory
Activation
Spallation
Transmutation
Burnup
$\frac{dN_i}{dt} = -N_i(\lambda_i + \sigma_i\varphi) + \sum_{j \neq i} N_j(\lambda_{ij} + \sigma_{ij}\varphi)$