

ABSTRACT

- The development of three independent databases is being carried out by research teams of NRC «Kurchatov Institute»:
 - Benchmark experiments for the verification of transport codes and evaluated nuclear data libraries;
 - Evaluated nuclear data libraries (ENDF/B, ROSFOND, etc.), integrated into the VISTUD hardware-software system for their storage, processing, and visualization;
 - Properties of functional and structural materials intended for the design of hybrid facilities;
- The developed databases are planned to be integrated into a unified management system.

BACKGROUND

The fusion neutron source (FNS) concepts under development at the NRC «Kurchatov institute» are based on a tokamak-type magnetic confinement system for DT plasma, equipped with a blanket containing nuclear materials. In the design of a FNS, a key aspects are: 1. simulation of neutron irradiation effects on the structural and functional materials of the facility; 2. verification of the obtained modeling results with experimental data; 3. selection of structural and functional materials according to their properties and service conditions. Structuring of benchmark experimental data, material characteristics, and evaluated nuclear data library files within a management system will facilitate the efficient and more safe development of technical solutions in the design of FNS and provide all project participants with access to up-to-date information.

IMPLEMENTATION

BENCHMARK EXPERIMENTS DATABASE

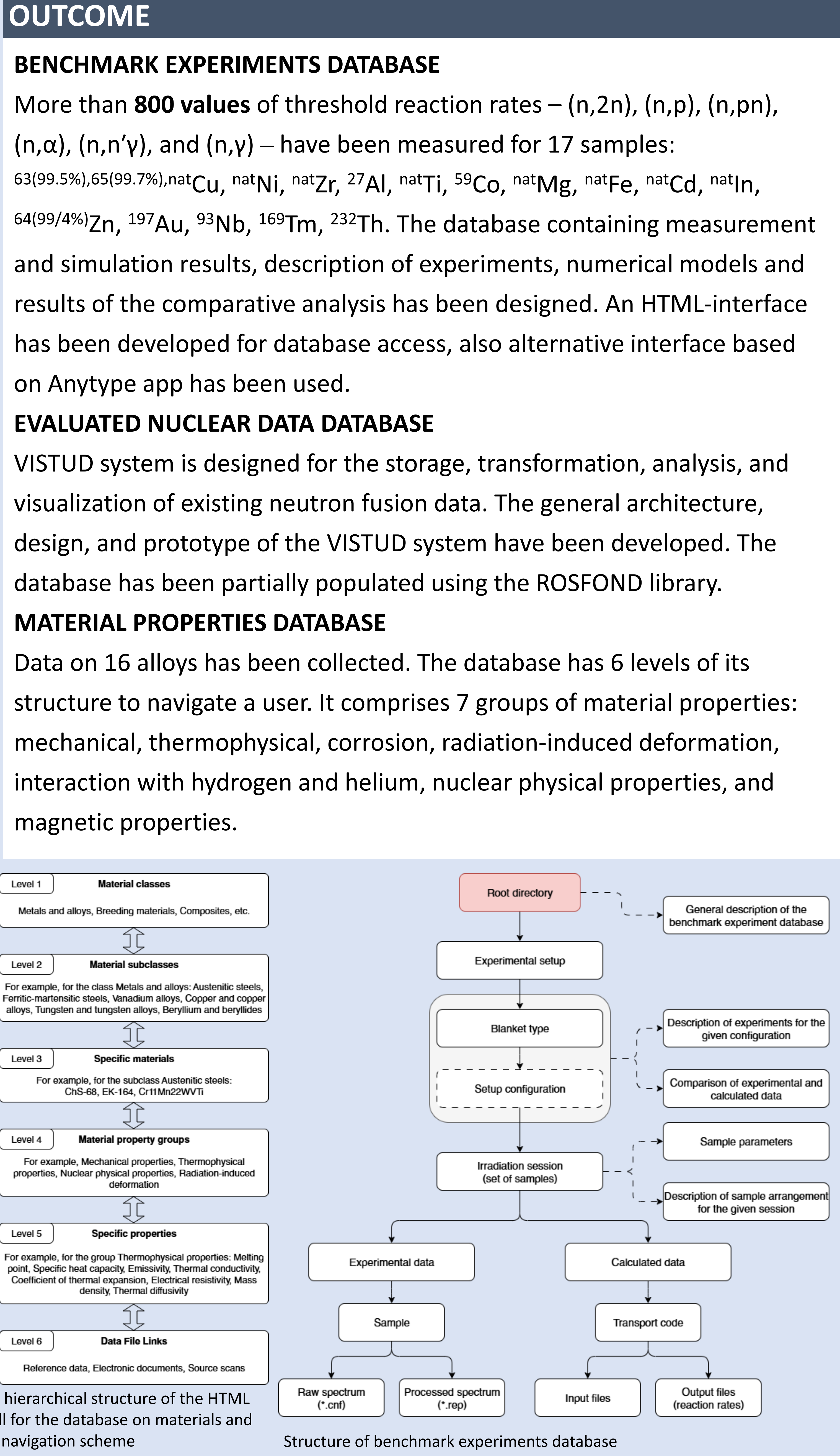
- The following facilities were employed for experiments:
 - NG-24 neutron generator with a fusion-like spectrum and an intensity of 1×10^{11} n/s;
 - I-2 linear particle accelerator with a beryllium target irradiated by protons with an energy of 20.8 MeV and an intensity of 6×10^{11} proton/s.
- Several types of micro-models of fusion blankets were used:
 - the “pure” NG-24 spectrum (without a blanket);
 - a molten salt blanket ($0.52\text{NaF} - 0.48\text{ZrF}_4$) with thermal and fast neutron spectra;
 - solution-based blankets;
 - beryllium target irradiated by protons.
- Numerical simulations were performed using various transport codes (KIR, MCNP, SuperMC, PHITS) and nuclear data libraries JEFF-3.3, JENDL-4.0/5, ENDF/B-VIII.0, ROSFOND-2010, FENDL-3.0, TENDL-2019, IRDFF-II.

EVALUATED NUCLEAR DATA DATABASE

- For a design of hardware–software system – Visualizer of Fusion-Controlled Data System (VISTUD) – a modern technological stack was used: SQL (PostgreSQL), Python, and C++;
- The VISTUD system consists of subsystems for management, data storage, computation, user interaction, and auxiliary infrastructure.

MATERIAL PROPERTIES DATABASE

- The database is populated with information from open sources and from research and development results.



CONCLUSION

- A benchmark experiment and material properties databases have been developed while VISTUD system is currently at the stage of user interface development and refinement of the remaining subsystems;
- The databases are being continuously expanded with new data, and tools for their processing are under development;
- The resulting system will support the efficient and more safe development of technical solutions for hybrid reactor design.

REFERENCES

[1] TITARENKO, Yu.E. et al., Verification of nuclear data libraries used to design molten salt blankets of a fusion neutron source, Annals of Nuclear Energy 211 (2025) 110983.

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[3] TITARENKO, Yu.E. et al., Benchmark Experiments Methodology on Base the Neutron Generator NG-24M and Micromodels of the Fusion Neutron Source (FNS), Problems of Atomic Science and Technology, Ser. Nuclear And Reactor Constants 2 (2023) 60.