SANDA WP5/Task 5.3 definition

Alberto Mengoni
on behalf of the ENEA

alberto.mengoni@enea.it

SANDA
Supplying Accurate Nuclear Data for energy and non-energy Applications
HORIZON2020

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Task 5.3: New integral experiments
Task coordinator: **CEA/DEN**, *partners:* **CVREZ, ENEA**

Subtask 5.3.1: Experiments at GELINA and CEA/DEN

The proposed experiments will consist in performing neutron transmission measurements at the JRC Geel GELINA facility using the same samples as those used in the CEA Cadarache MINERVE reactor as part of the past CERES Burnup Credit programme. Preliminary studies show that such experiments should be feasible. Each sample is made of a UO_2 matrix with a small admixture of a fission product: Sm, Nd, Cs, Mo, Ru, Eu, Gd, or Rh. The expected outcome will be a set of transmission data for each sample. These data will be first used to determine the amount of contaminants in the samples by Neutron Resonance Transmission Analysis (NRTA). The knowledge of the relative amount of such contaminants will help improve the analysis of the past MINERVE measurements. In a second step, a combined analysis of the MINERVE spectrum-averaged data and the GELINA microscopic energy-dependent data will help improve the fission product cross section data in the resonance region.

Subtask 5.3.2: Experiments at LR-0, CVREZ and CEA/DEN

The flexible zero-power LR-0 critical facility at Rez and its well-defined neutron spectrum will be used to create benchmark-quality nuclear data validation conditions:

- Full characterization of a critical 235U-fuelled configuration (criticality, power distribution and spatial distribution of flux and reaction rates) for an IRPhEP-quality type benchmark;

- Direct and indirect measurements of the 235U prompt fission neutron spectrum, especially the high-energy tail. The direct method uses neutron spectrometry techniques while the indirect method uses low uncertainty flux monitors. Some of the neutron detectors developed under WP1 could also be tested on that occasion;

- Measurements of spectrum-averaged cross sections in well-characterized neutron spectra (from fast to thermal), obtained by spectrum shaping arrangements using high-purity graphite moderation.

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Subtask 5.3.3: Experiments at TAPIRO, ENEA and CEA/DEN

The TAPIRO fast neutron source reactor at the ENEA Casaccia centre near Rome will be used to measure minor actinide spectrum-averaged cross sections. The program, called AOSTA, will consist of minor actinide irradiations and fission cross section measurements. Reference major actinides will be also measured in the same spectral conditions. Delayed gamma peak spectrometry will be used to infer capture cross sections, while dedicated miniature fission chambers containing pure deposits of actinides will be used to measure fission cross sections. As for Subtask 5.3.2, the AOSTA program could provide the opportunity to test some of the neutron detectors developed in WP1.

Although only the leading organizations are named across each subtask, it is expected that other project partners will be interested and will volunteer contributions to the above experimental programs in due course.

At the outcome of this Task 5.3, valuable new validation data are expected and will be made available broadly. The subsequent use of this experimental information for nuclear data validation will provide some indication of the remaining gaps to improve evaluated files and meet target performance. Recommendations will be made as to the best course of action to bridge this gap, knowing that there is only a very small number of zero-power experimental reactors still in operation worldwide.

Should difficulties arise with one of the above subtasks, resources could be redirected to experiments in another facility. In particular, innovative (semi-)integral transmission-type experiments could be considered at one of the JRC Geel facilities, in the GELINA target hall or at the MONET tandem Van-de-Graaff. Such experiments would consist in studying transmitted beams of MeV-energy neutrons thru a stack of plates made of pure material (^{238}U, Fe, Na, MgO…). The stack thickness would be optimize for maximizing the activation detectors sensitivity to neutron inelastic scattering in the stacked material. Preliminary simulations suggest that such an experiment would be feasible.

Deliverables
D.5.12 Report on integral experiments at TAPIRO; ENEA, CEA
when: M42
D.5.13 Report on new integral experiments and needs; CEA, JRC, CVREZ, ENEA
when: M48

SANDA WP5/Subtask 5.3.3 status

- The COVID situation implied a delay in all activities at TAPIRO, with delays of 1 to 1.5 years
- Only recently (in 2023), the activity resumed with priorities given to the backload accumulated
- Restoring of the activities in the framework of the ENEA-CEA AOSTA agreement further delayed the planning
- MA samples have been already delivered to ENEA Casaccia, and discussions are going on with CEA to define the planning for their irradiation within the SANDA termination deadline

TAPIRO (acronym for TAratura PIIa Rapida a potenza zerO) is a nuclear research reactor located at the ENEA Casaccia Research Centre, near Rome, Italy.

The END