

REACTORS AND NUCLEAR SAFETY

Mission and Objectives | Achievements

Mission and Objectives

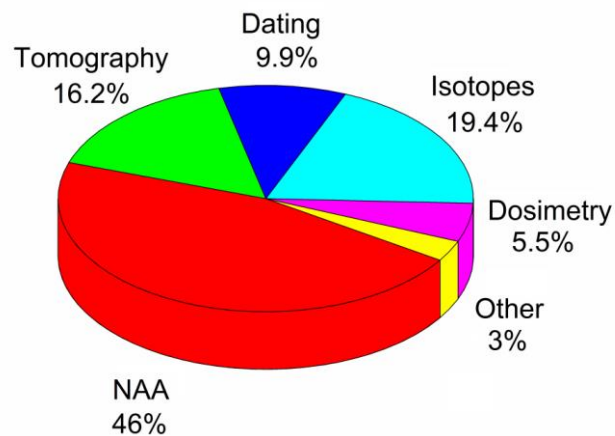
The main mission of this unit is the operation of the Portuguese Research Reactor (RPI), in order to satisfy the user's needs while conducting all tasks with the assurance that the reactor is operated in a safe and reliable manner. The Neutron Activation in Environment, Nutrition and Epidemiology (NANE) group is the main user of the RPI and focus its activities on the development of neutron activation analysis (NAA) methodologies and their application to environment, nutrition and epidemiology studies, while the Applied Dynamics Laboratory (ADL) group does research in the area of vibration and acoustic problems, both of industrial and fundamental nature.

Main Achievements

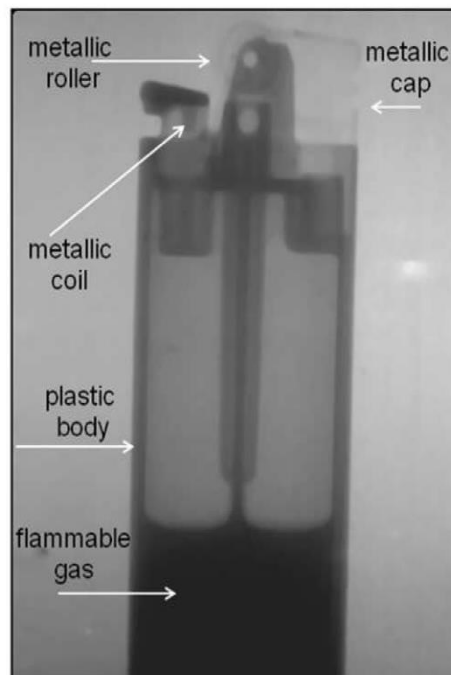
- The RPI was available for its users 192 days in 2013. A total of 497 irradiations were performed, corresponding to 1131 h of reactor time. The main activity supported by the RPI was Neutron Activation Analysis (NAA), which accounted again for about 50% of the use of the reactor. Other significant activities were neutron radiography, isotope production and irradiations for dating with the $^{40}\text{Ar}/^{39}\text{Ar}$ method.
- Significant improvements were made in neutron imaging using solid state nuclear track detectors. Although these detectors have been used for charged particle detection for several decades, their use in neutron radiography resulted in images with very low contrast. We have used an enriched boron-10 screen as a neutron to charged particle converter and digitised the images using a flatbed scanner with a new procedure resulting in a better contrast. In this way it was possible to obtain a significant reduction on the optimum neutron fluence to obtain a neutron radiography image.
- Within the SIMPLE project, significant progress was made in the understanding of particle discrimination using superheated droplet detectors. Three experiments use the superheated liquid technique: PICASSO, COUPP and SIMPLE, albeit with different molecules, respectively, C_4F_{10} (R-610), CF_3I (R-1311) and C_2ClF_5 (R-115). Only SIMPLE reported a clear separation between neutron- and α -induced events which was a surprising result. We have shown that this happens because an α particle achieves a LET above the critical level only in a small range of 32-40 μm of liquid penetration, resulting on a size cut-off for bubbles with radius below 16 μm .
- Within the PM-Fugitive project, receptor and dispersion models were used to estimate the environmental impact of fugitive emissions in the industrial area of Mitrena, Setúbal. Results showed fugitive emissions represented an increase in the PM10 concentration which highly

depended on the season. It was found that on average fugitive emissions contribute to 20% of PM10, in summer, and to 4%, in the winter;

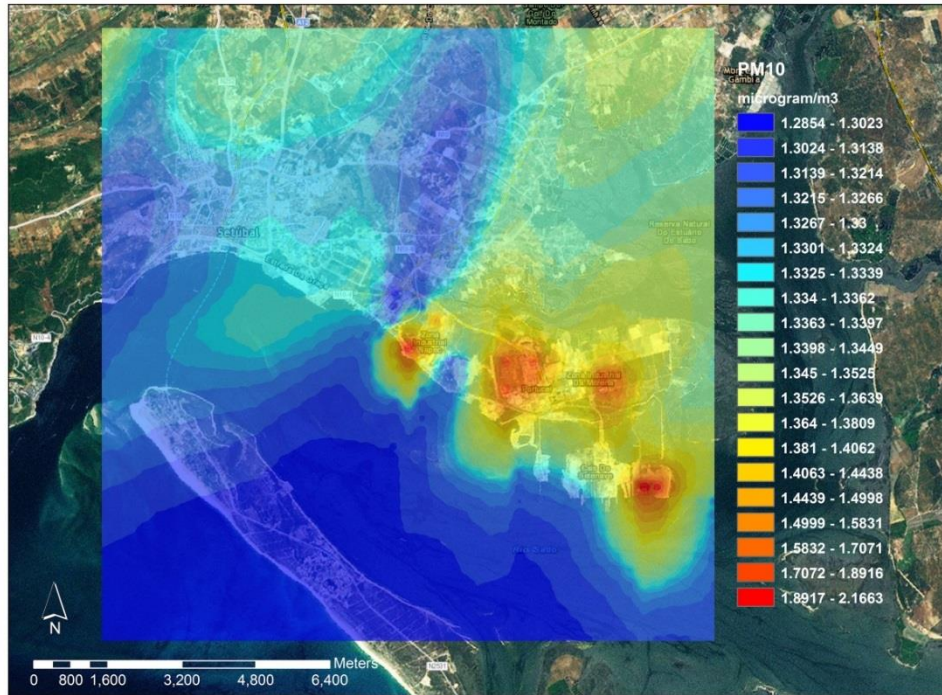
- A general strategy to identify the turbulence excitation from measurements of nuclear fuel rod response vibrations was further developed in collaboration with CEA-Saclay and applied to multi-supported fuel bundles, a quite delicate inverse problem. We also developed original refined methods for the estimation of unmeasured cross-spectra and cross-correlation functions from a limited set of measured data, in order to reconstruct incomplete measurement matrices. The four data reconstruction techniques developed in 2013 to address difficulties in this project can potentially be also used within a large body of other identification problem fields.



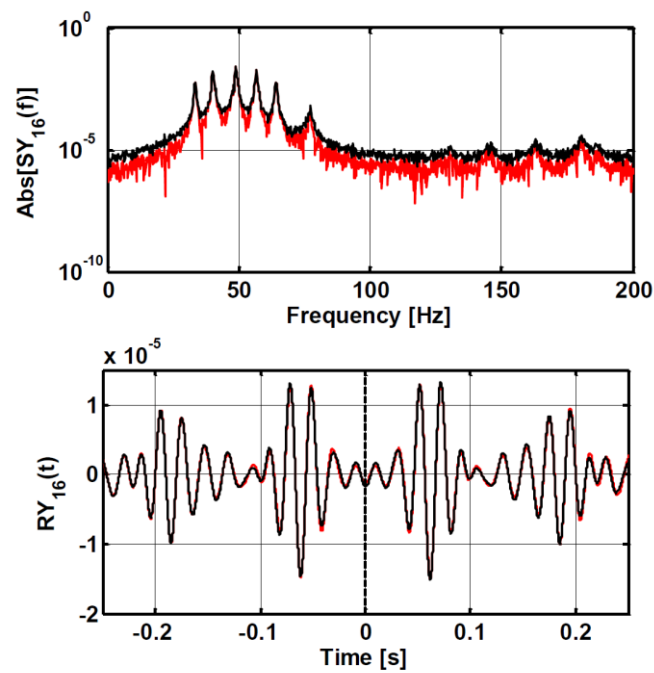
Main activities in the RPI in 2013.



Neutron radiography of a gas lighter. The image was recorded using a CR-39 solid state nuclear track detector and digitized using a HP4370 scanner.



Contribution of fugitive emissions in Summer (Mitrena – Setúbal).



Illustrative results of an original method for the estimation of non-measured data from an incomplete set of measurements: reference (black) and the corresponding estimated (red) cross-spectrum and cross-correlation functions.