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#04-25 Characterization of neutron emission during pulse mode of low output electronic neutron generator

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Portable electronic neutron generators are an established technology that can be used for many lab and field applications. Offering significant regulatory and operational benefits over radionuclide neutron sources, they start to be more widely used at universities and research centres. Beside the established industrial applications (e.g., in logging or mining industry), applications are being developed for fields including security, safeguards, or waste characterization. They are becoming more used for E&T in nuclear engineering, nuclear analytical techniques, or nuclear related fields.
Electronic neutron generators can be utilized for many analytical techniques (including NAA, PGNAA, DNC, DDA). In many cases, the pulsed operation of the generator is used to improve the efficiency of the applied methods. Neutron generators can provide information on neutron production via a TTL signal that can be used for triggering the data acquisition system. However, to improve the interpretation of the measured data, the knowledge on the time profile of neutron production within the pulse duration is important. This can be achieved experimentally by a proper neutron detection system. The response of the neutron detection system is formed by neutrons of different energies for detection systems designed to measure thermal, epithermal, and fast neutrons. For various applications, specific frequencies and pulse durations can be needed. Thus, various frequencies may require or enable various approaches to efficiently relate the neutron detector response to the neutron emission by the generator within the required time resolution. Monte-Carlo particle transport codes are efficient tools to simulate it.
The paper deals with the characterisation of the neutron output profile during neutron pulsing of a neutron generator. First, it provides a validation of time-dependent calculations in MCNP Monte Carlo code showing the role of several model simplifications on the achieved results. Second, it compares the applicability of thermal, epithermal and fast neutron detection systems for pulse characterisation. The study is performed for two cases: first, the generator and detector are placed in a moderated environment; second, the equipment is placed in a free space. Calculations are performed in MCNP6 code. The study includes experimental data measured with the D-D P-385 Thermo Fisher Scientific neutron generator with a maximal neutron output of 7 x 10^6 n/s for several frequencies.

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