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High Count Rate Thermal Neutron Detectors and Electronics

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He-3 proportional counters and analog electronics are the backbone of neutron detection systems. 1"He-3 tubes have been used with classical electronics for over three decades. The major challenge for short dead time and operation in high gamma fields, including spent fuel measurement, are difficult to address by simply changing the gas admix and tweaking the shaper time constants, resulting in thick shielding with added size and cost. Those small gains are adequate for spent fuel measurements of some lower burnup LEU assemblies, but not for MOX fuel or advanced fast reactor fuel, where the neutron source term is even greater. In this paper we report the Next Generation Safeguards Initiative's (NGSI) and GE Reuter Stokes systematical efforts to develop the next generation of thermal neutron detectors and front-end electronics addressing that technology gap:

• A cost-performances metric of tube diameter and gas pressure has been developed

• New tubes with redesigned electrodes (reduced tube diameter and increased anode diameter) for better use of He-3 gas, improved time response and gamma resistance

• New front-end electronics with double pulsing filtering and dual channel architecture expanding many times the measurement capabilities over current technology

• In-field calibration and status of health instrumentation for thermal neutron detectors

The He3 and 10B tubes with new electronic package allows the operation at higher count rates and in higher gamma fields, as well as offering the possibility of more efficient use of He-3. These devices, which are being commercialized, can also be used by themselves to upgrade conventional detector systems, enabling possible solution to measure spent nuclear fuel with high neutron efficiency previously not possible in systems that used 235U fission counters in the past.

Country or International Organization

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