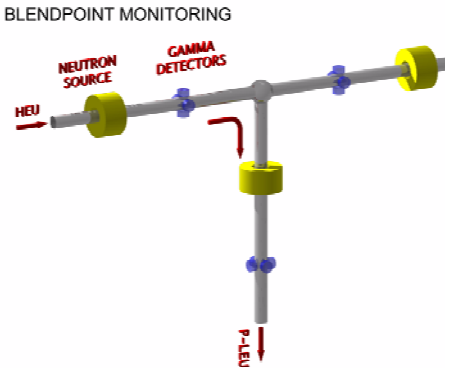
Fissile Mass Flow Monitor

Measurement of Fissile Mass Flow in Piping Systems

ORNL has developed a system that measures the flow of U-235 in gaseous media flowing in pipes. The system is in use by the NNSA's Highly Enriched Uranium – Transparency Implementation Program in Russian enrichment plants (since 1999).

Basic principles of operation



Californium-252 neutron sources produce neutrons which are moderated in energy and then allowed to go through the steel pipe. Shutters are open and closed to produce a time-varying beam of neutrons into the pipes. The neutrons cause fissions in the uranium-235 flowing through the pipes. The fissioning uranium results in fission products which emit gamma rays and neutrons. Downstream of the californium neutron source assemblies, gamma detectors indicate the presence of the fission products. By measuring the time between shutter opening and first indication of fission products downstream, we measure the velocity of the fissile material. Measurement of the intensity of the 185-kev peak from the uranium-235 indicates how much is in the pipe. A combination of the velocity measurement, the intensity of the 185-kev and a pressure measurement, we can determine the mass flow rate of uranium-235.

Importance of the measurement

- This measurement is non-intrusive. No piping penetrations are required beyond what normally already is there.
- The measurement is not sensitive to the flow of other gases (non-fissile) in the piping.
- The measurement system is designed to operate continuously for several years.
- The system is in operation now in Russia. In this application, an Enrichment Monitor designed by LANL is used to determine the enrichment of the uranium in the pipe.

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