

**Y-12
OAK RIDGE
Y-12
PLANT**

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**BLENDDOWN MONITORING SYSTEM
FOR HEU TRANSPARENCY**

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BLENDDOWN MONITORING SYSTEM FOR HEU TRANSPARANCY

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The High Enriched Uranium (HEU) Purchase Agreement between the United States (U.S.) and the Russian Federation (RF) provides for the monitoring of the blending of highly enriched uranium (500 metric tons) with low enrichment blend stock uranium (LEU) to produce commercial reactor-grade material for use in U.S. reactors. A Blend Down Monitoring System (BDMS) has been developed by the U.S. Department of Energy (DOE) to provide unattended monitoring of the HEU blending operations at the Russian facilities. It is configured to monitor the mass flow rate developed by the Oak Ridge National Laboratory (ORNL) and ^{235}U isotopic enrichment developed by Los Alamos National Laboratory (LANL) of gaseous UF_6 in three separate flow streams at a blending “tee”.

The fissile mass flow monitor (FMFM) has two functions: measure the mass flow rate of fissile material in a process pipe and trace the flow of the fissile material from the HEU leg to the product LEU leg. To achieve these functions, the FMFM induces fissions in the fissile stream and detects the delayed gamma rays emitted by fission fragments at a downstream detector location. The induced fissions are modulated using a neutron-absorbing shutter to create a time-dependent signature that is detected by the down stream detectors (Figure 1). The FMFM (Figure 2) determines the fissile mass flow rate by relying on two independent measurements: (1) the time required for the fission fragments to travel along a given length of pipe, which is inversely proportional to the fissile material flow velocity, and (2) an amplitude measurement, which is proportional to the fissile concentration (e.g., grams of ^{235}U per unit length of pipe). Fissile

traceability is accomplished by detecting the presence of time-modulated fission fragments produced by the neutron modulation in the HEU stream in the product LEU process stream at a detector downstream of the blending “Tee”.

The enrichment monitoring system, installed down stream from the FMFM, uses gamma ray spectrometry to measure the 186 keV gamma ray from ^{235}U to obtain the ^{235}U content of the gas. It also measures transmission through the gas of 122 keV gamma ray from a ^{57}Co source to obtain the total uranium in the gas. These two gamma ray measurements determine the enrichment.

Some features of the BDMS are that it provides confirmation of mass flow and material traceability, non-intrusive measurement of gaseous or liquid fissile material, fully automated operation and data recording, fully self contained system, and is designed for unattended operation.

The BDMS has been installed and successfully demonstrated in the Paducah Gaseous Diffusion Plant operated by Lockheed Martin Utility Services, Inc. for the U.S. Enrichment Corporation and regulated by the Nuclear Regulatory Commission. In these tests the enrichment varied from 1.5 down to 1.1%. Equipment for two BDMS units has been shipped to the Russian Federation and one has successfully operated at the Urals Electro Chemical Integrated Plant (UEIP) at Novouralsk and the other is for installation at the Electrochemical Plant at Zelegnogorsk.

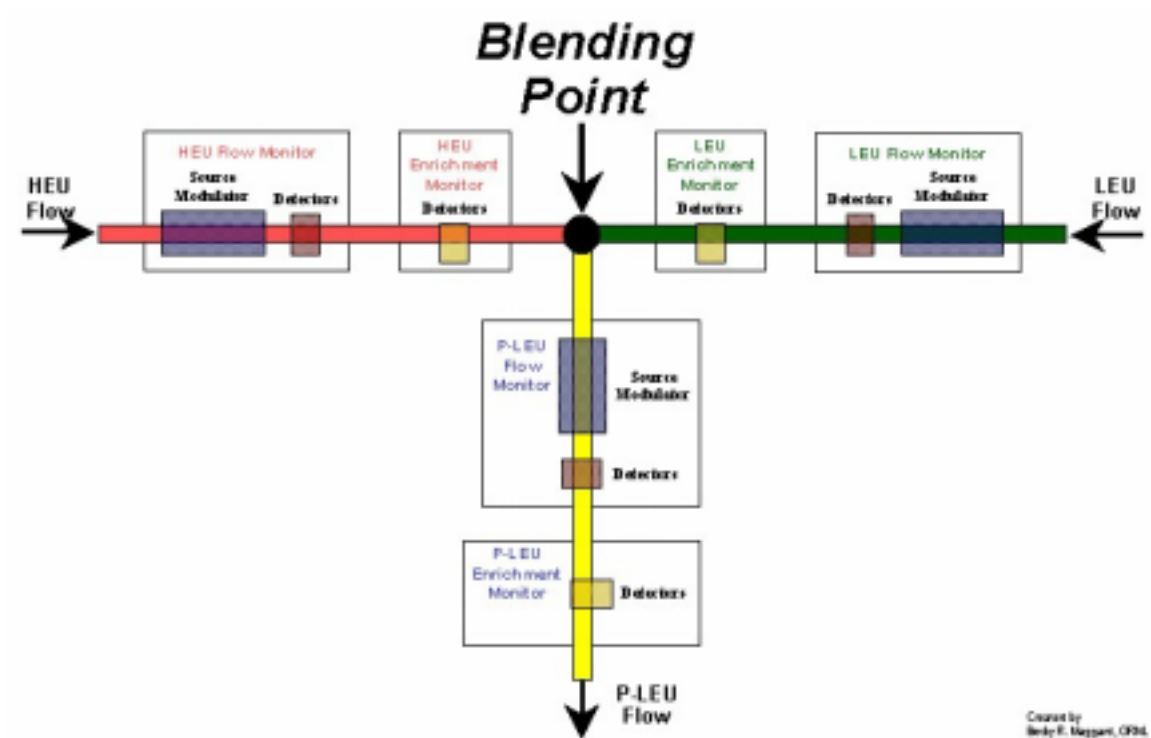


Figure 1. Schematic of the Blending Tee.

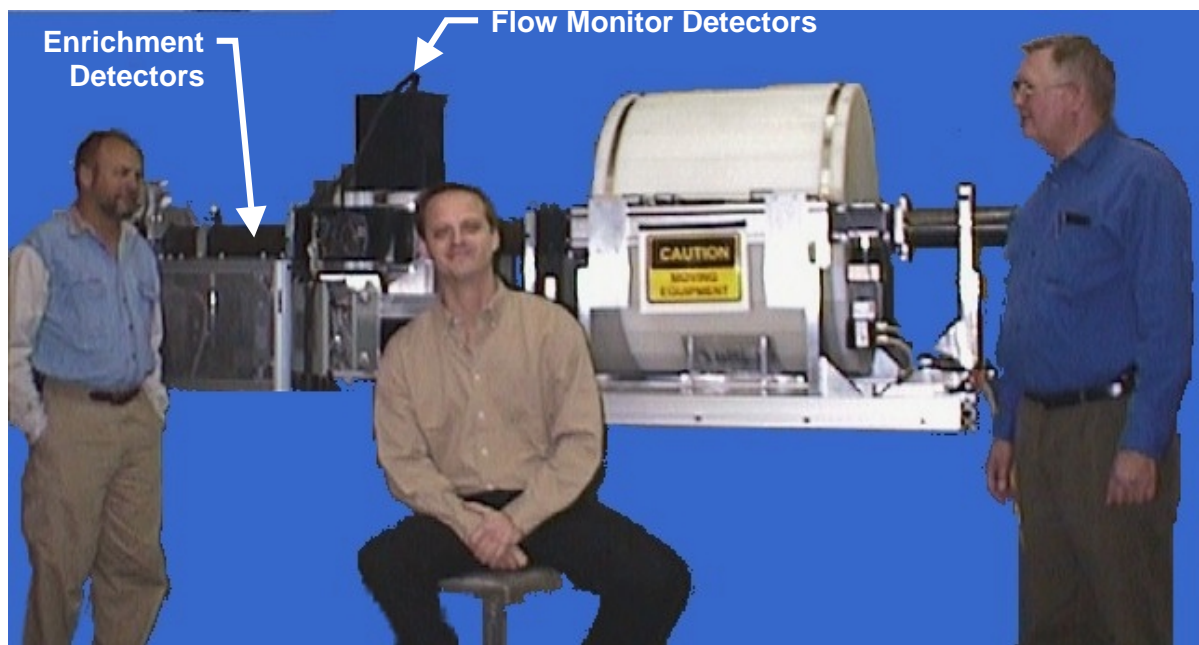


Figure 2. Blenddown Monitoring System for HEU Transparency.