Monitoring the Destruction of Russian Nuclear Weapons: The HEU Transparency Program

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STATEMENT BY THE PRESS SECRETARY

U.S.-Russia Mark Major Nonproliferation Milestone

Today, the United States and Russia issued a Joint Statement to mark an important milestone: the completion of the conversion of the equivalent of 10,000 Russian nuclear warheads into fuel for nuclear reactors that provide 10 percent of America's electricity.

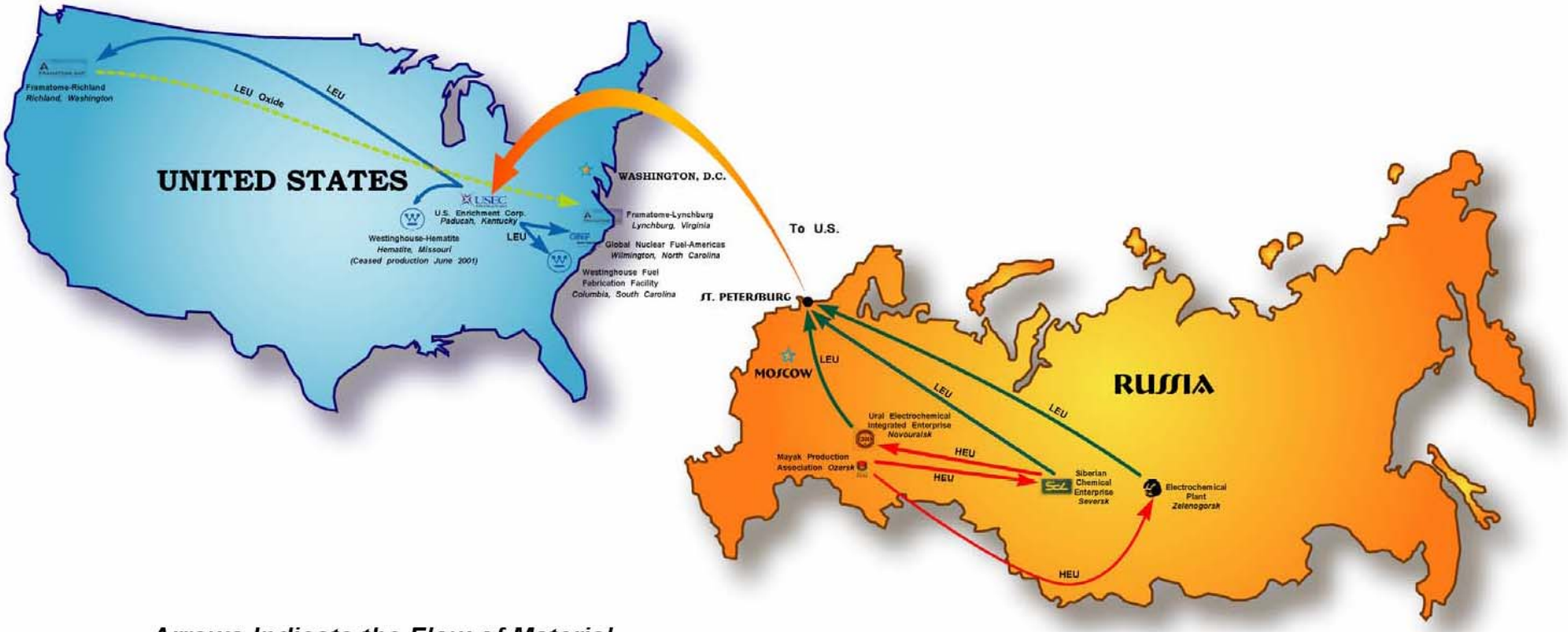
Marking this important nonproliferation milestone underscores the success of U.S. nonproliferation cooperation with Russia in eliminating highly-enriched uranium (HEU) from dismantled Russian nuclear warheads and converting the material to peaceful uses.

In 1993, the United States and Russia signed an agreement to down-blend 500 metric tons of HEU from Russian nuclear weapons (enough for 20,000 weapons) to low-enriched uranium (LEU). Today, at the halfway point of this program, the United States and Russia remain committed to completing the down-blending of the remaining material by 2013.

HEU Purchase Agreement

- On February 18, 1993, the United States and Russian Federation signed the historic HEU-LEU Agreement. The U.S. agreed to purchase 500 MT of HEU from dismantled Russian nuclear weapons, in the form of 15,000 metrics tons of LEU, for use as reactor fuel for U.S. commercial power reactors.
- The US receives 30 MT-HEU (~1000 MT-LEU) every year. Sufficient to supply half the fuel needs of all US nuclear reactors.
  - **10% of US electric energy has its origin in dismantled Russian nuclear weapons**

Facilities Subject to the Agreement



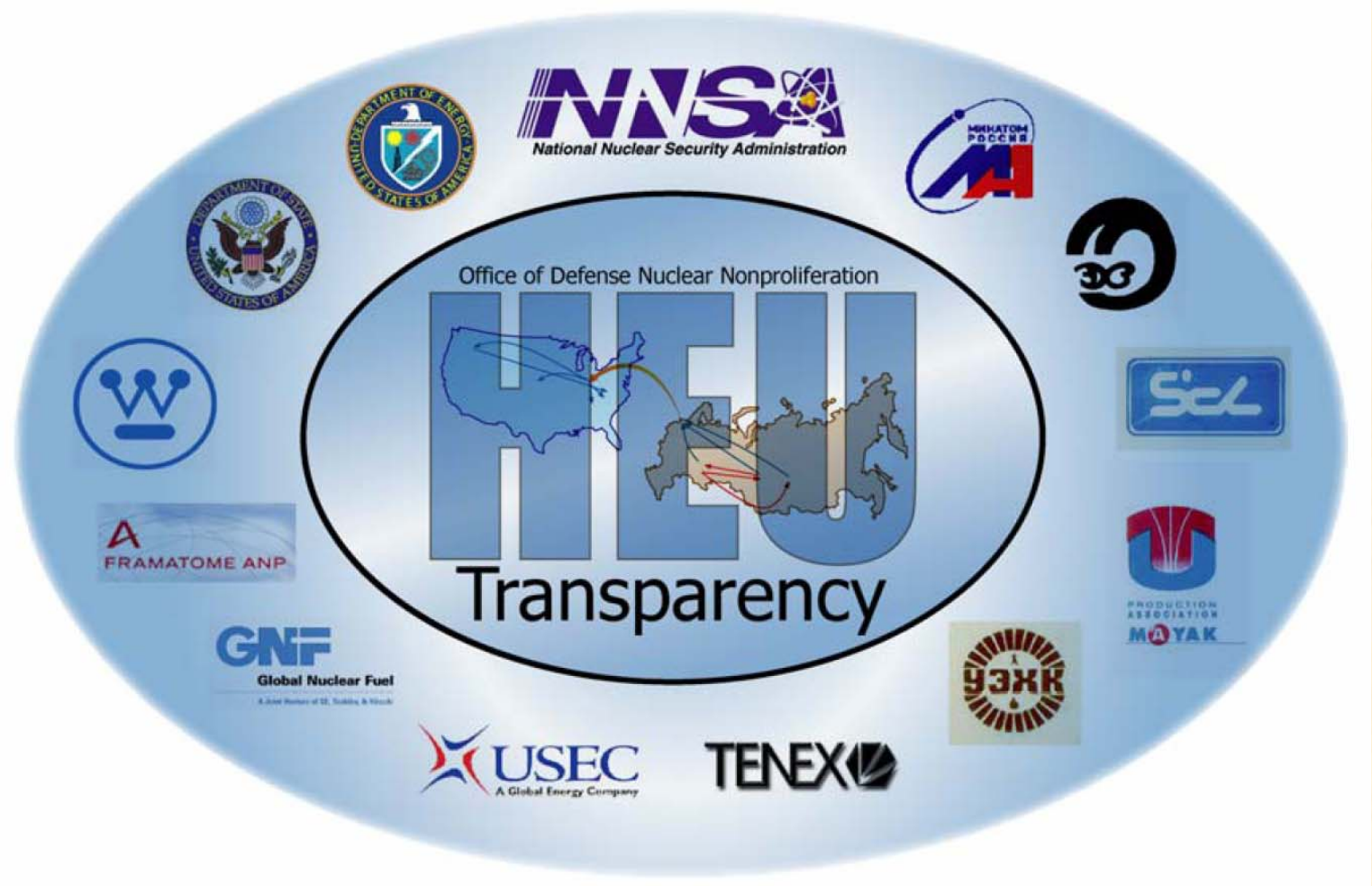
Arrows Indicate the Flow of Material

Red is HEU Gold / Blue / Green is LEU

HEU Transparency Program

- **On March 18, 1994, the sides signed a Protocol on HEU Transparency Arrangements establishing transparency measures.**
  - **Assures the permanent removal of 500 metric tons (MT) of weapons-usable highly enriched uranium (HEU) from use in Russian nuclear weapons.**
  - **Monitors the processing and down blending of the HEU into low enriched uranium (LEU) for shipment to the United States for use as nuclear fuel in commercial power reactors.**

United States/Russia HEU Agreement



Transparency is What Keeps the Agreement Going

- **Transparency provides confidence that:**
  - **HEU extracted from dismantled Russian nuclear weapons is converted and downblended to LEU**
  - **The LEU shipped to the United States is fabricated into fuel for commercial nuclear reactors**
- **These measures support U.S. and R.F. nonproliferation policy initiatives to irreversibly eliminate excess weapons-usable HEU for peaceful purposes.**
  - **Converting excess HEU to LEU to fuel U.S. commercial power reactors provides both nonproliferation and economic benefit to the United States and Russia**

HEU Transparency Ensures:

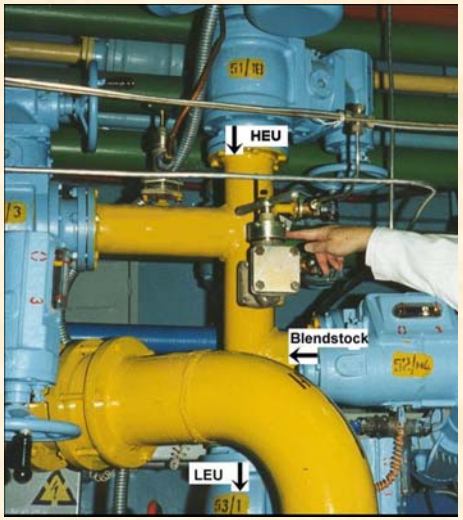
Objective One
500 MT is from Russian weapons-usable material.

Tactical nuclear device

Objective Two
This same HEU is converted to an oxide

Russian facility glove box where HEU metal is burned and converted into oxide

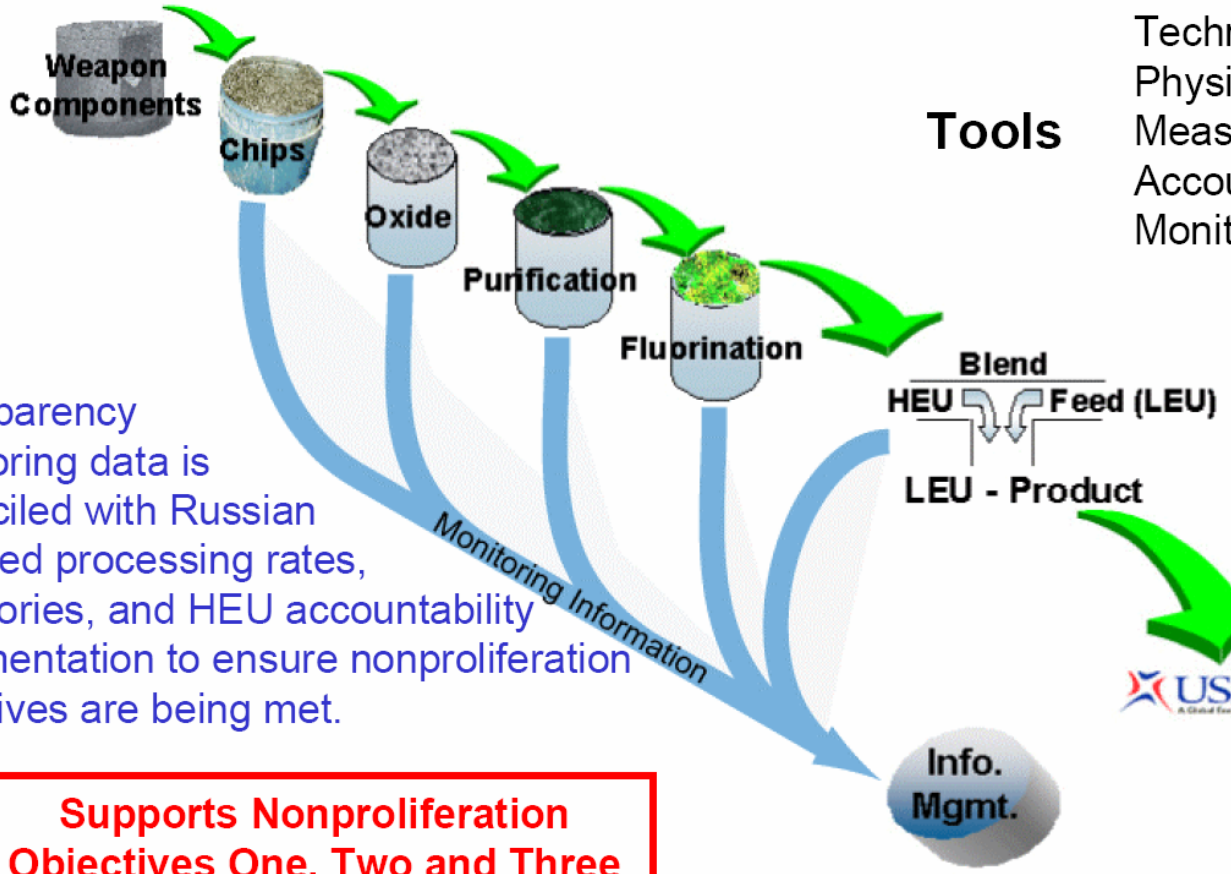
Objective Three
This same HEU is downblended to LEU



HEU Blendpoint in Russian Plant

Transparency Process

Monitors gather data on material processing rates and material containers in Russian plant storage and process areas.



Tools

- Technical Experts
- Physical Observations
- Measurements
- Accountability Documents
- Monitoring Information

Russia — U.S.

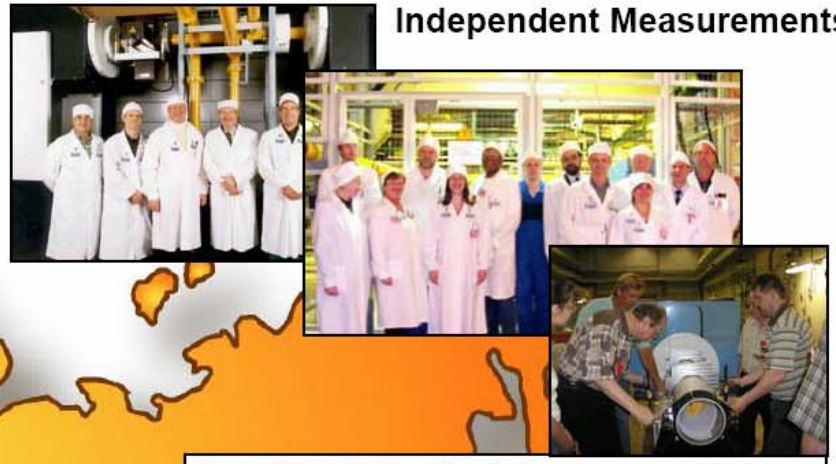
Transparency monitoring data is reconciled with Russian declared processing rates, inventories, and HEU accountability documentation to ensure nonproliferation objectives are being met.

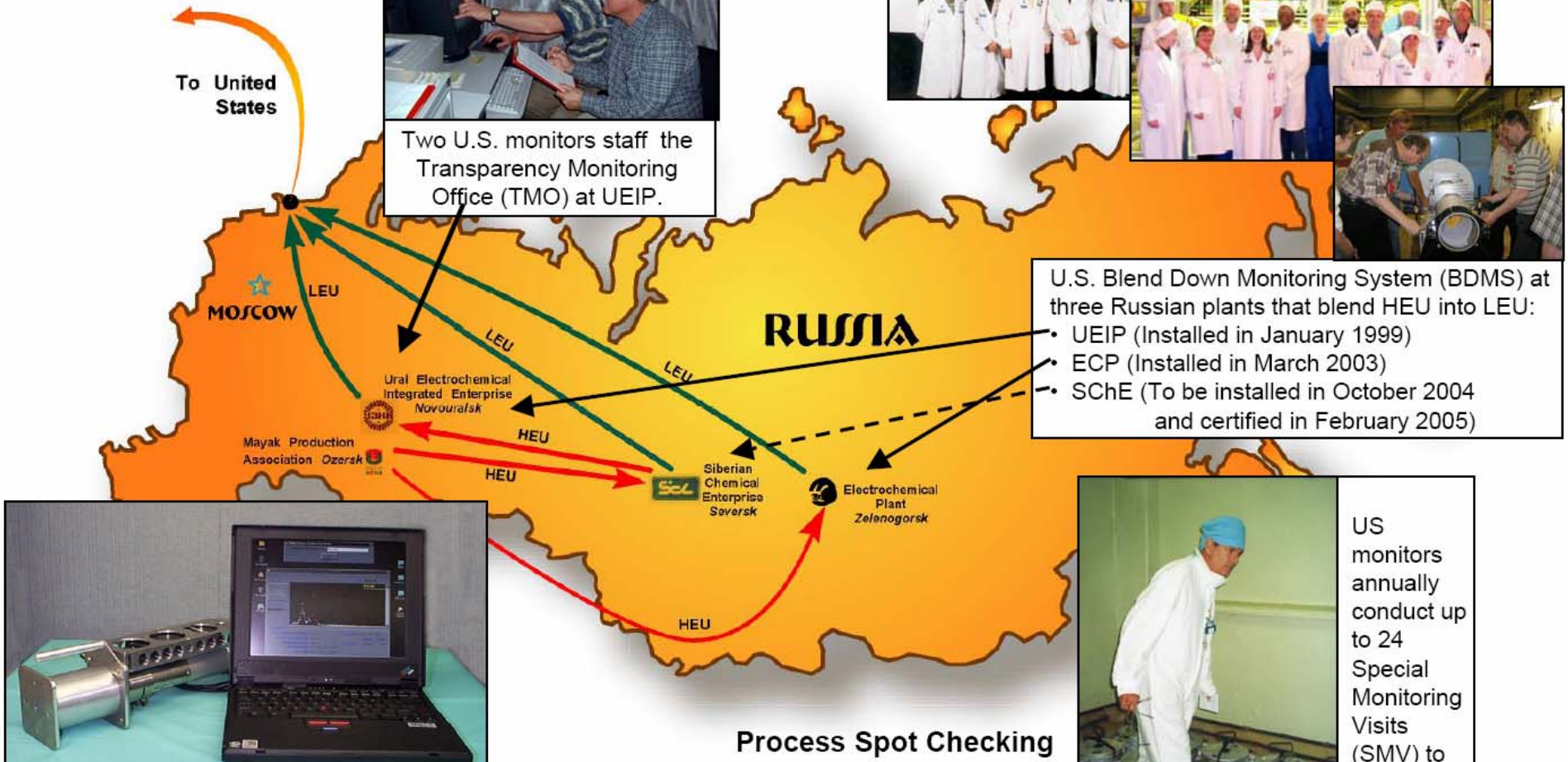
Supports Nonproliferation Objectives One, Two and Three

Process Spot Checking MC&A records

Two U.S. monitors staff the Transparency Monitoring Office (TMO) at UEIP.

Independent Measurements





U.S. Blend Down Monitoring System (BDMS) at three Russian plants that blend HEU into LEU:

- UEIP (Installed in January 1999)
- ECP (Installed in March 2003)
- SChE (To be installed in October 2004 and certified in February 2005)

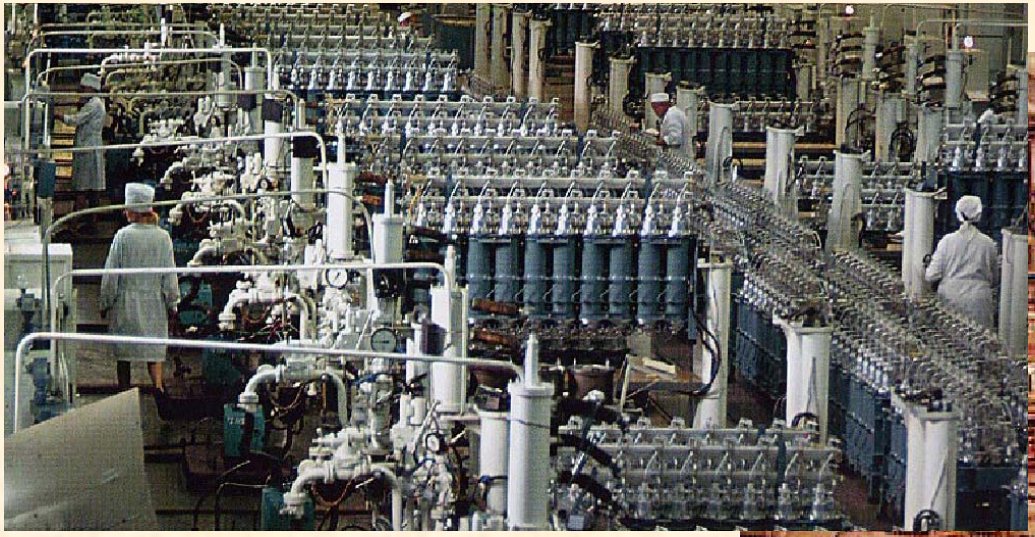
New portable nondestructive assay (NDA) instrumentation is used at the four plants to assure 90% ^{235}U assay of HEU in processing operations.

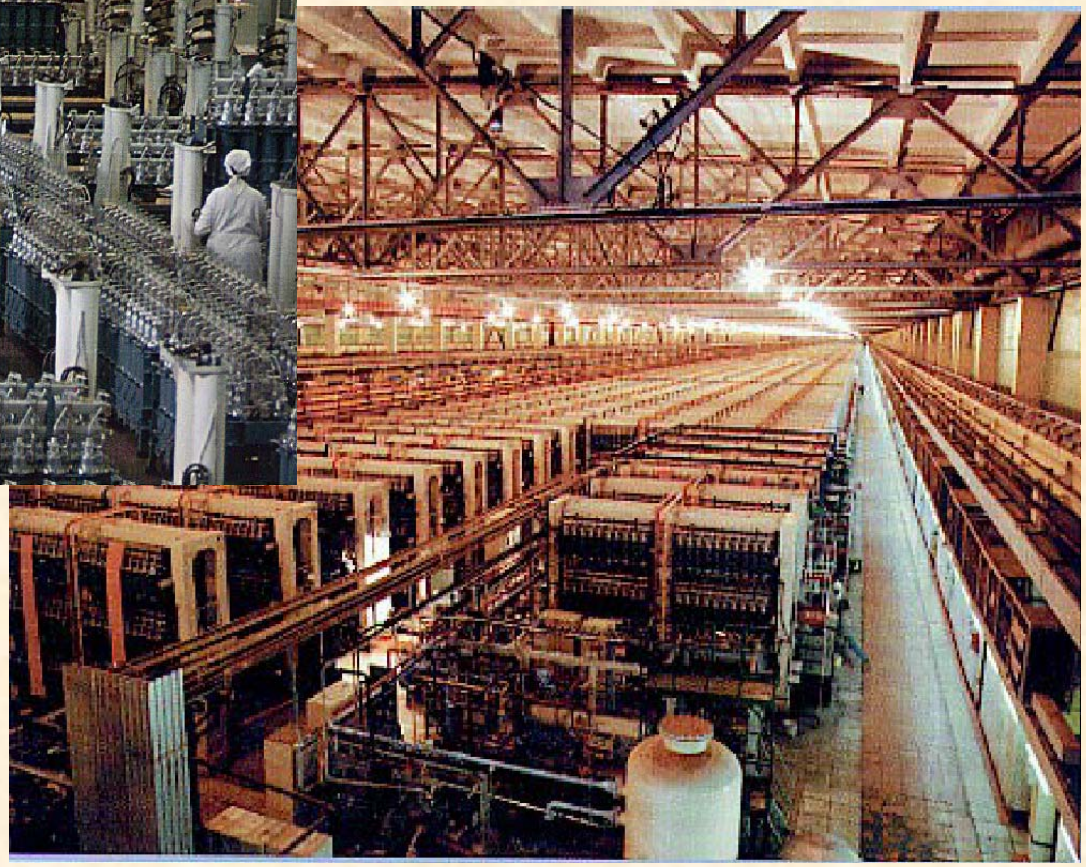
Process Spot Checking

Independent Measurements

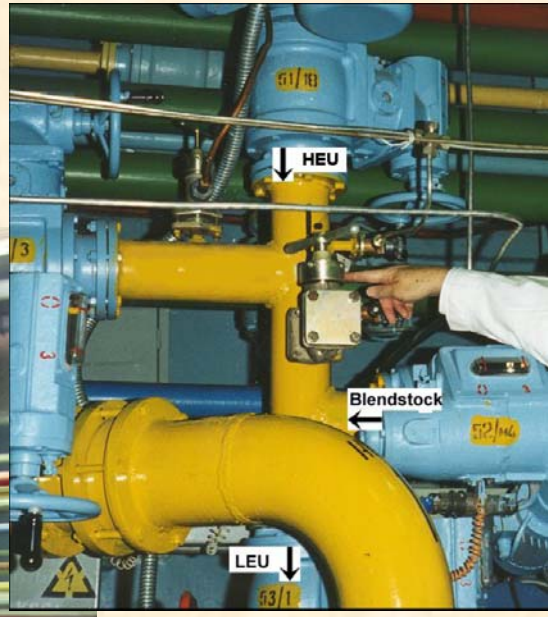
US monitors annually conduct up to 24 Special Monitoring Visits (SMV) to the four Russian plants.

Typical Enrichment Facility





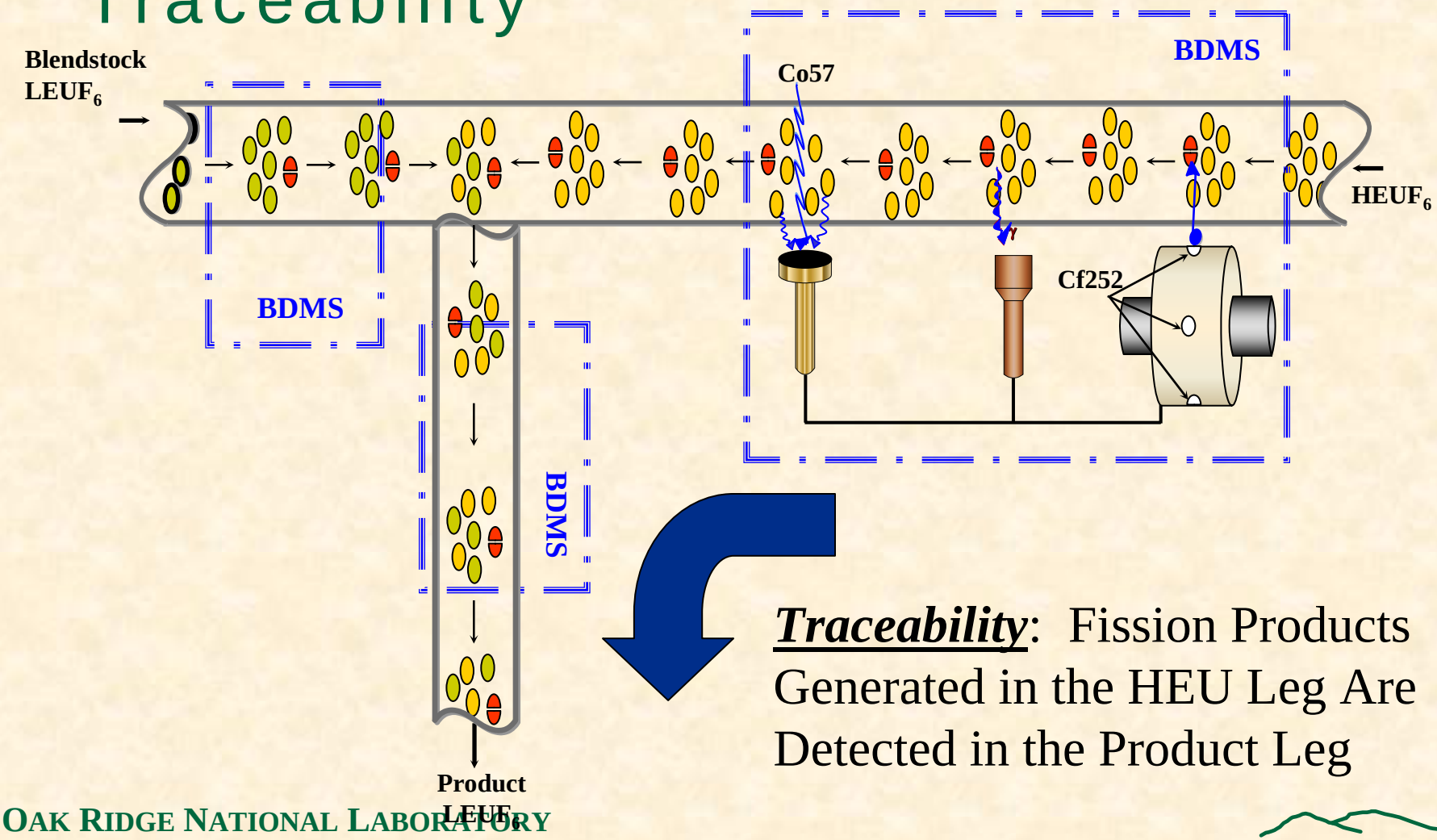
HEU Blending Facility



Blend Down Monitoring System

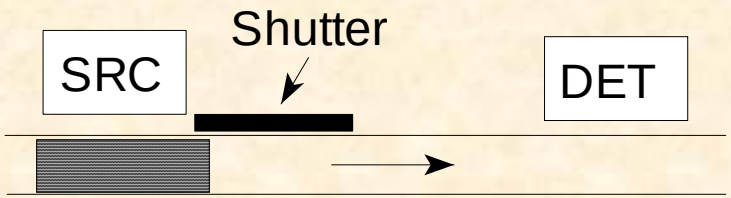
- **Key instrument for Transparency**
- **Installed in all 3 Russian Plants**
  - **Collects data 24/7**
  - **Serviced during routine SMVs (6 times/year)**
  - **Sealed in between SMVs**

BDMS Consists of 3 Measurements: Mass Flow, Enrichment, and Traceability

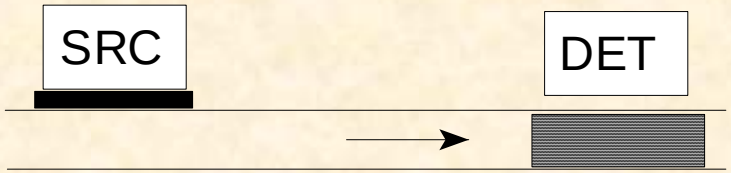


Traceability: Fission Products Generated in the HEU Leg Are Detected in the Product Leg

Flow Monitor Concept

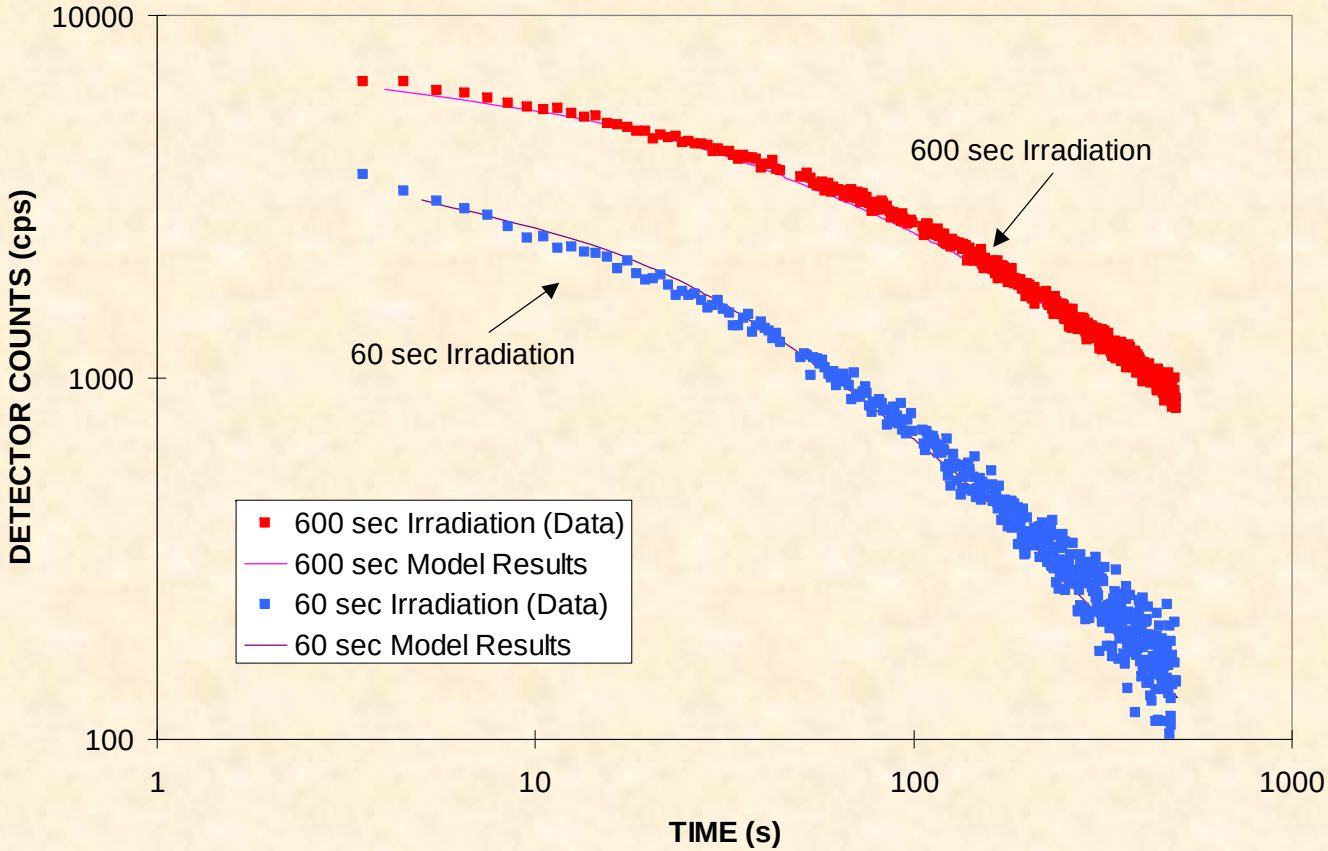


When the shutter opens, fissions are induced and fragments are carried by the fissile stream.

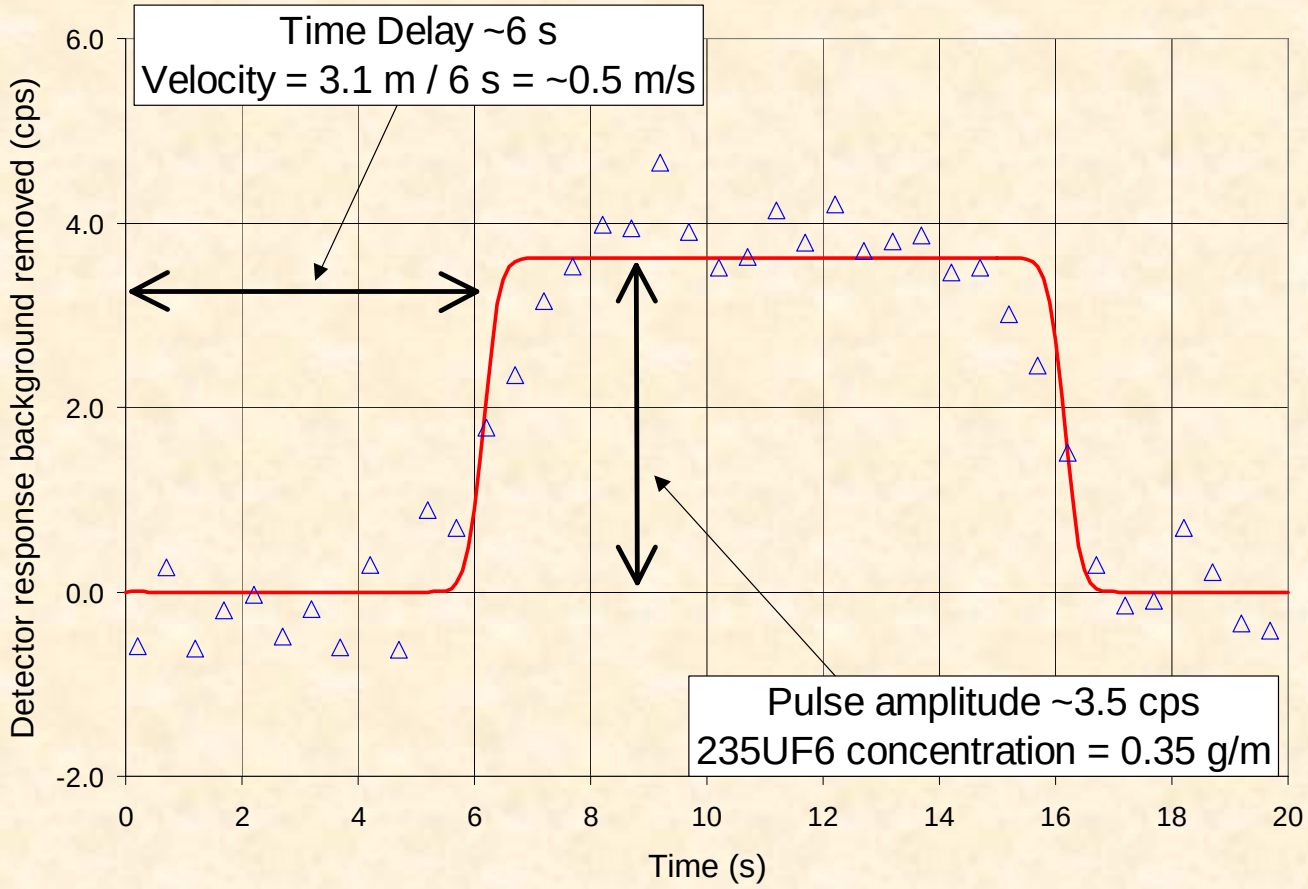


Fission fragment gammas are detected with a time delay.
Velocity % 1/Delay
Fissile concentration % Amplitude

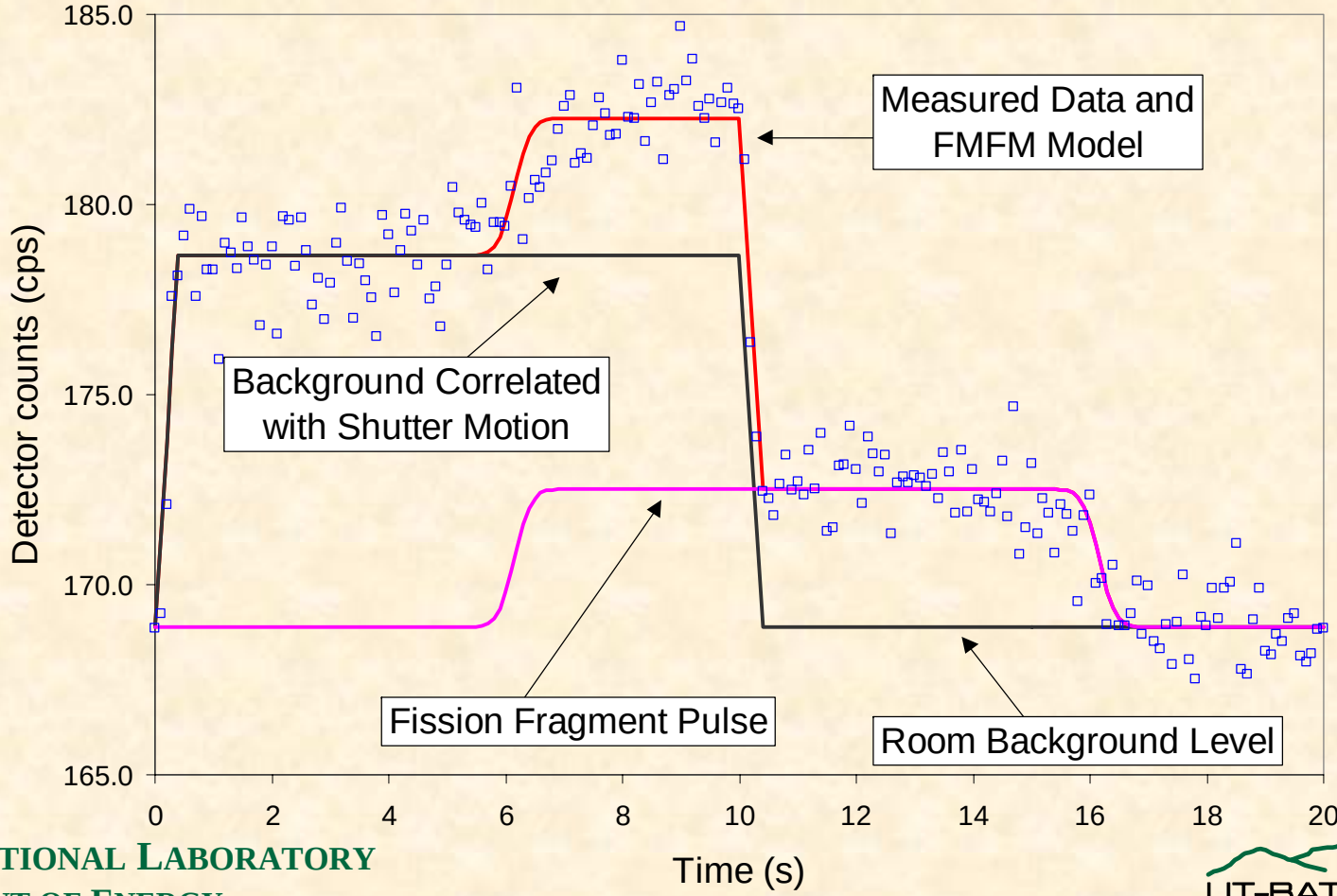
Fission Fragments Gamma Rays Can Be Measured Even After > 100 sec Delay



We Perform Two Measurements: Velocity and Density



Measured Signal Has 3 Components: Background, Correlated Background, and Fission Fragment Delayed Gamma Pulse



Fissile Mass Flow Monitor (FMFM) Algorithm

- **Algorithm identifies the three signal components that minimize the error between the measured signal and a theoretical model**
  - **Uncorrelated (room) background**
  - **Background correlated with shutter motion**
  - **Fission fragment pulse**

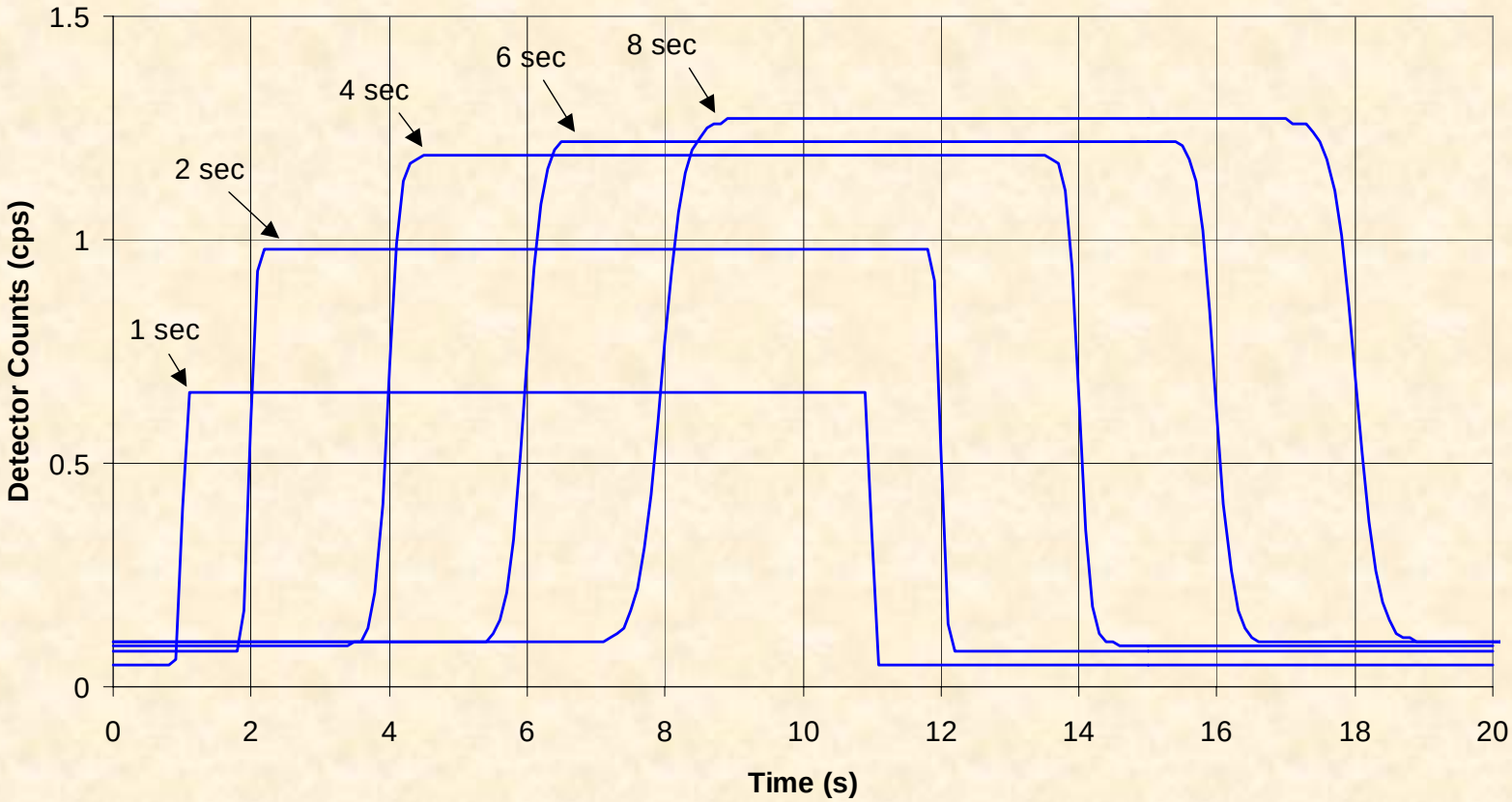
- **Flow parameters (gas density and velocity) are derived from the size and location of the fission fragment pulse**

Measured Data Require a Physical Model for Interpretation

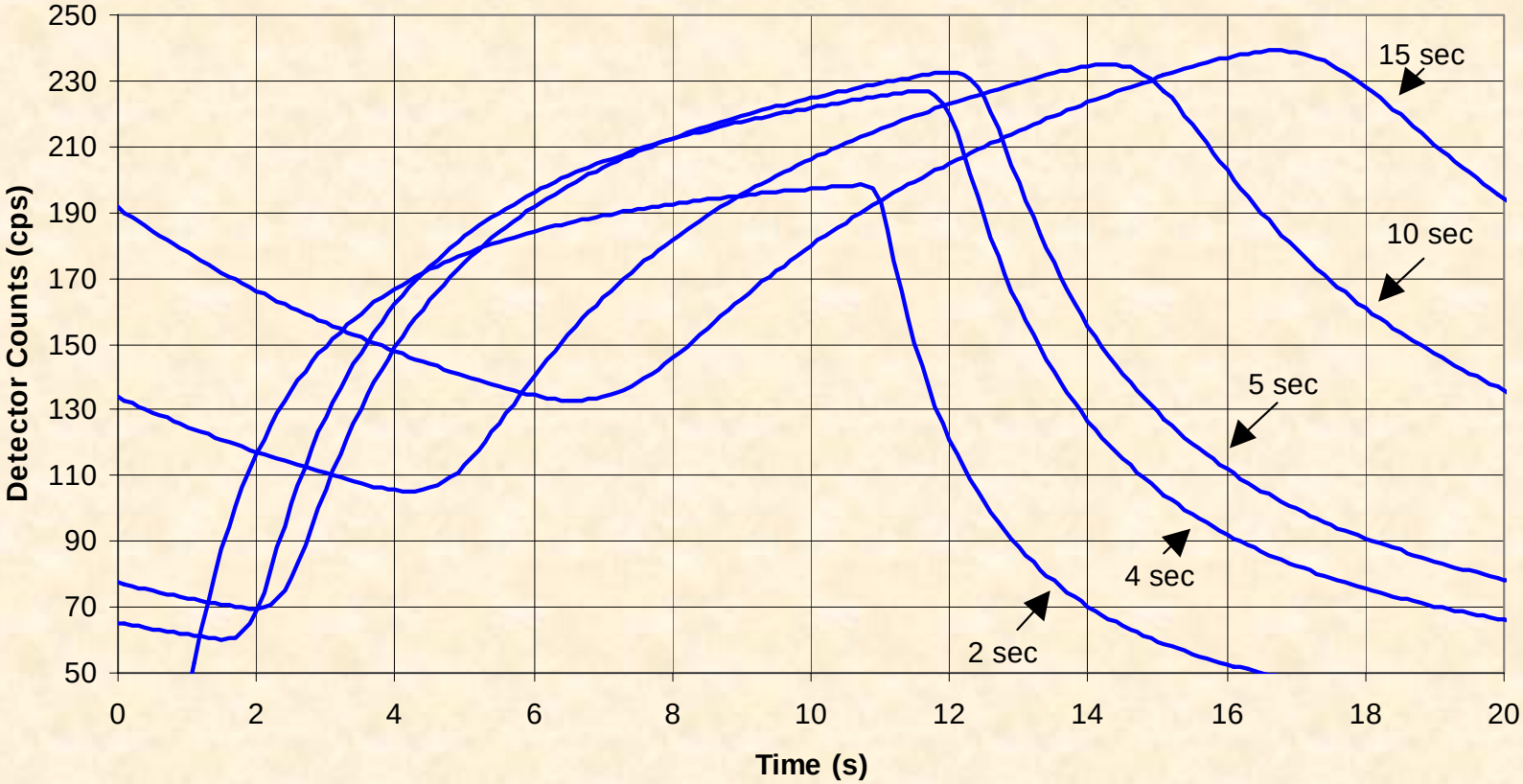
- **Physical process has been modeled**
  - **252Cf neutron moderation and source field of view**
  - **Fission fragment slow down in UF6**
  - **Fission fragment transport and decay**
  - **Detector efficiency and field of view**

- **Data base of detector profiles has been generated and is used by the FMFM software**

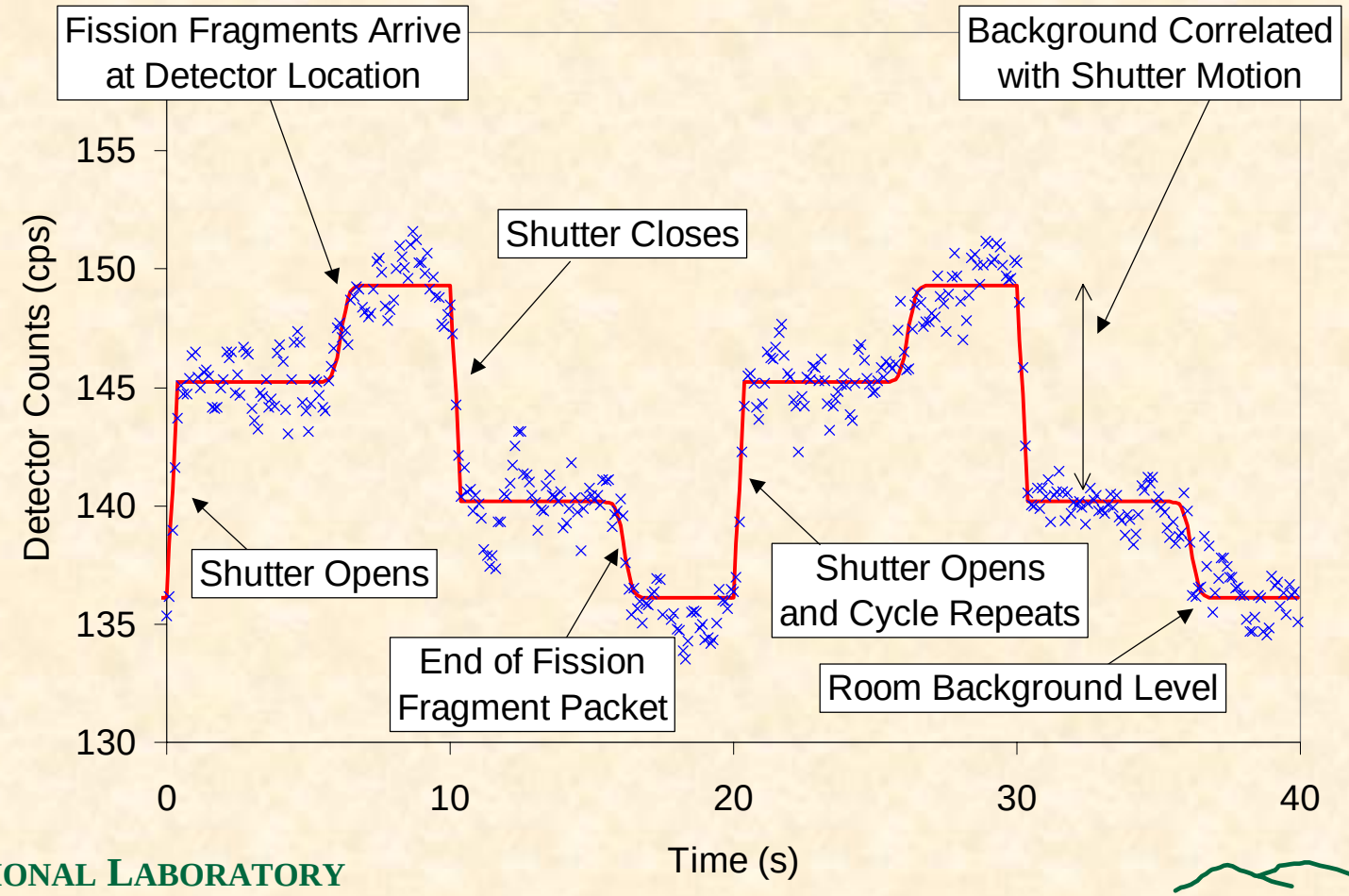
Detector Profile Data Base: Turbulent Flow



Detector Profile Data Base: Laminar Flow

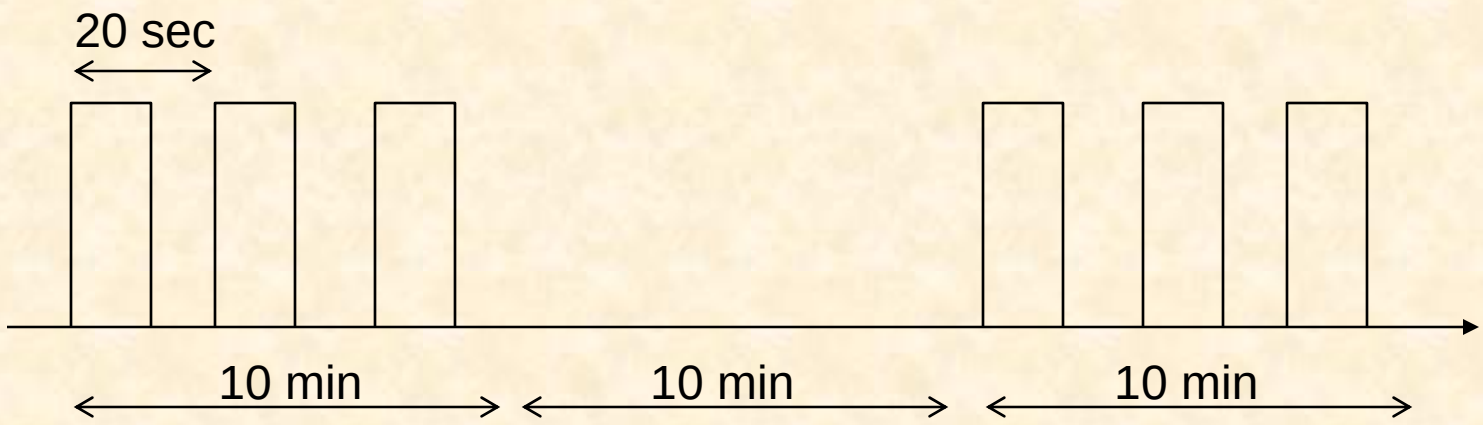


Data is Collected Over a Number of Shutter Cycles to Improve Signal/Noise Ratio



Fissile Tracing Algorithm

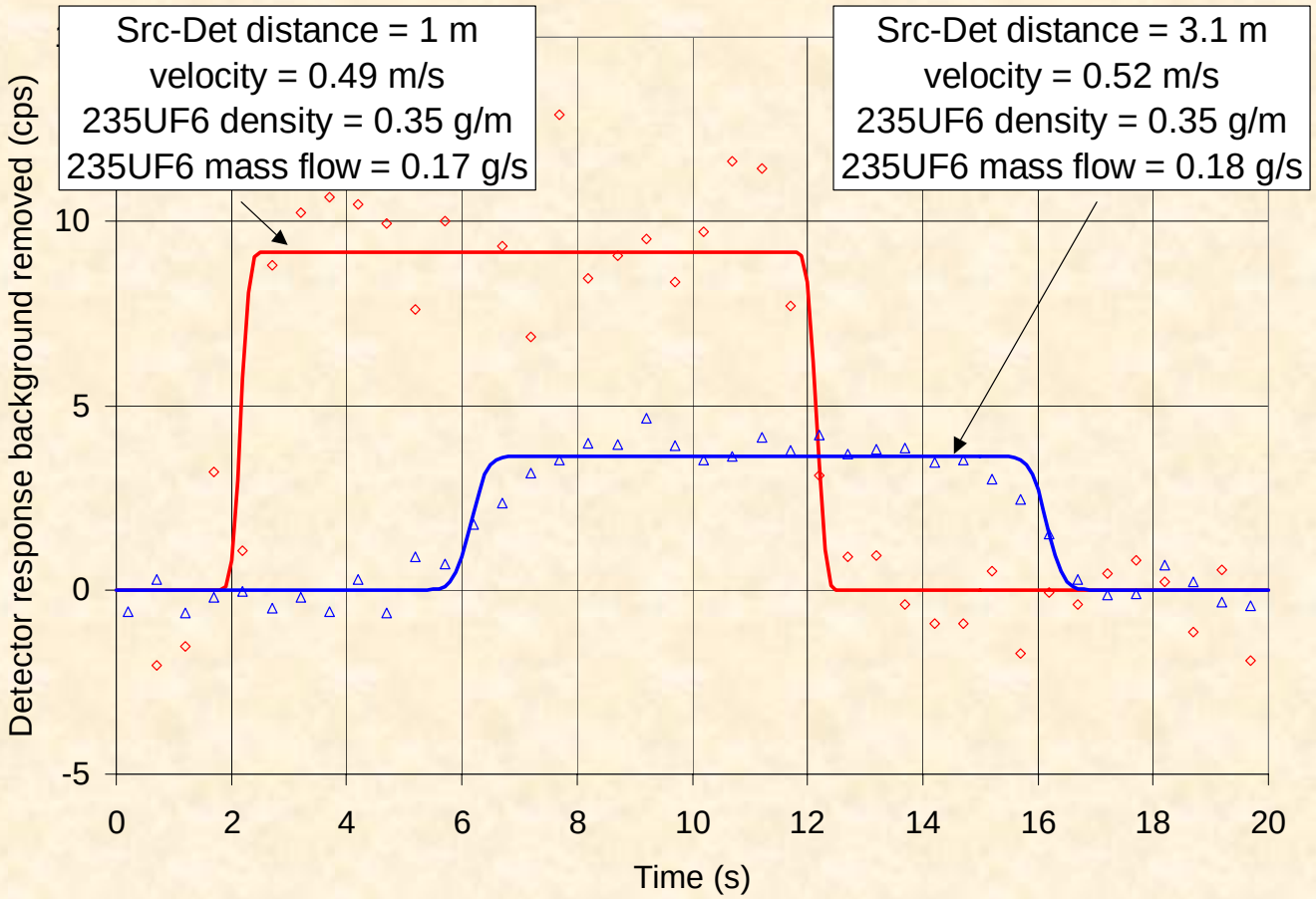
- **Low-frequency signature is superimposed in the HEU fissile stream by modulating the HEU shutter and is detected in the product stream.**



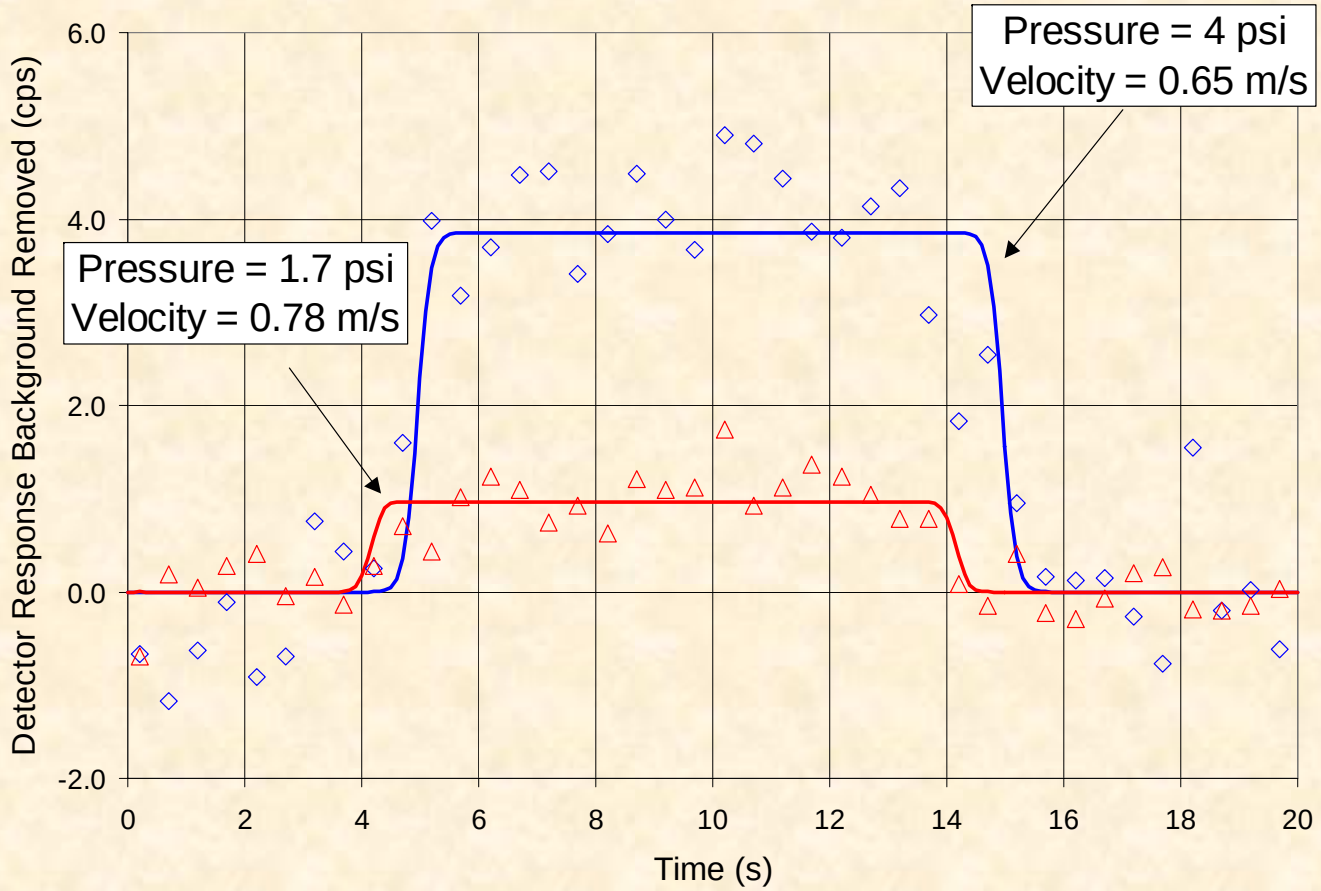
FMFM Algorithm Results

- **U235F6 velocity, density, and mass flow rate**
- **Quality of the flow measurement**
- **Quality of the traceability measurement**

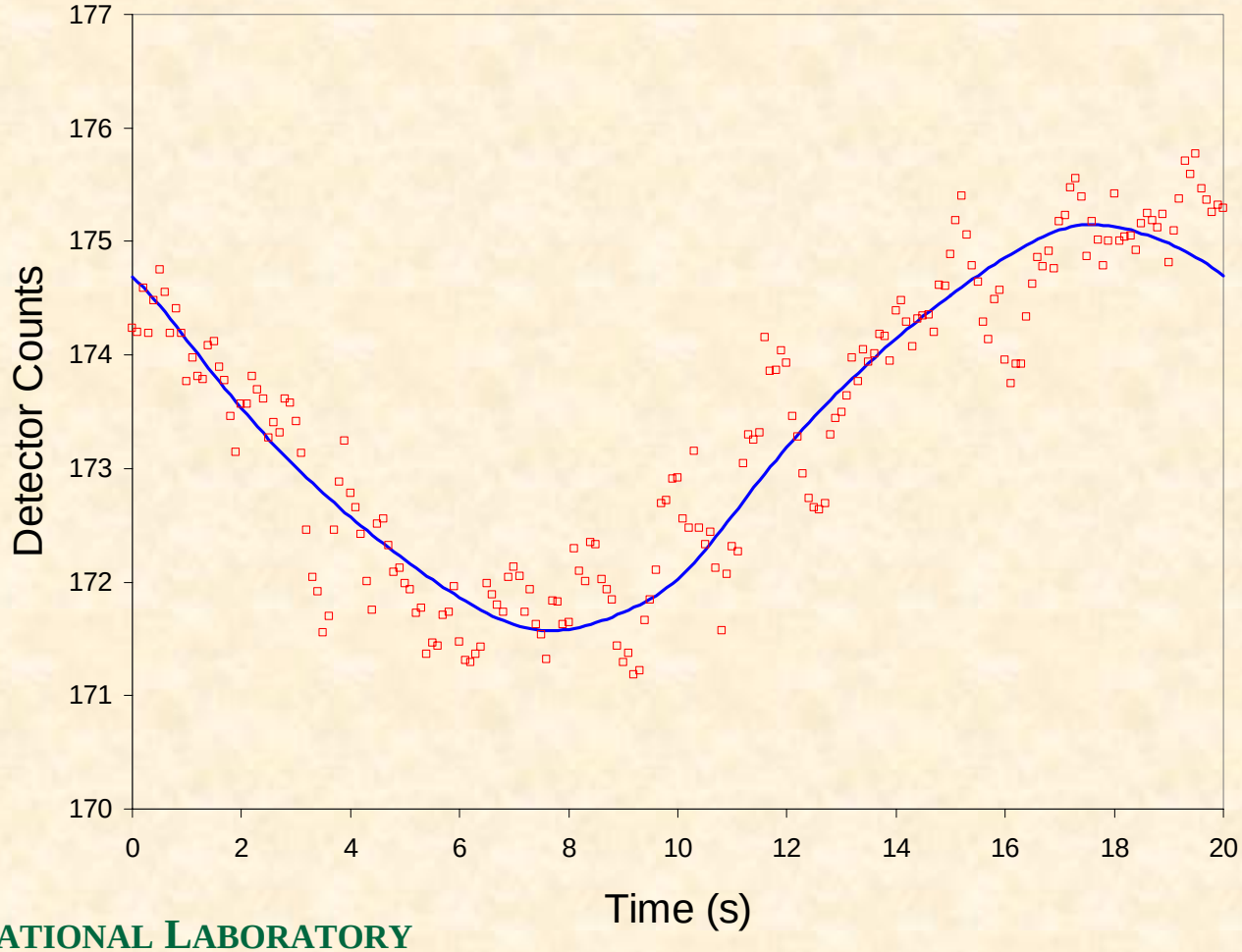
Model-Calculated Profiles Match Demo Data: Two Detector Distances, Same Flow



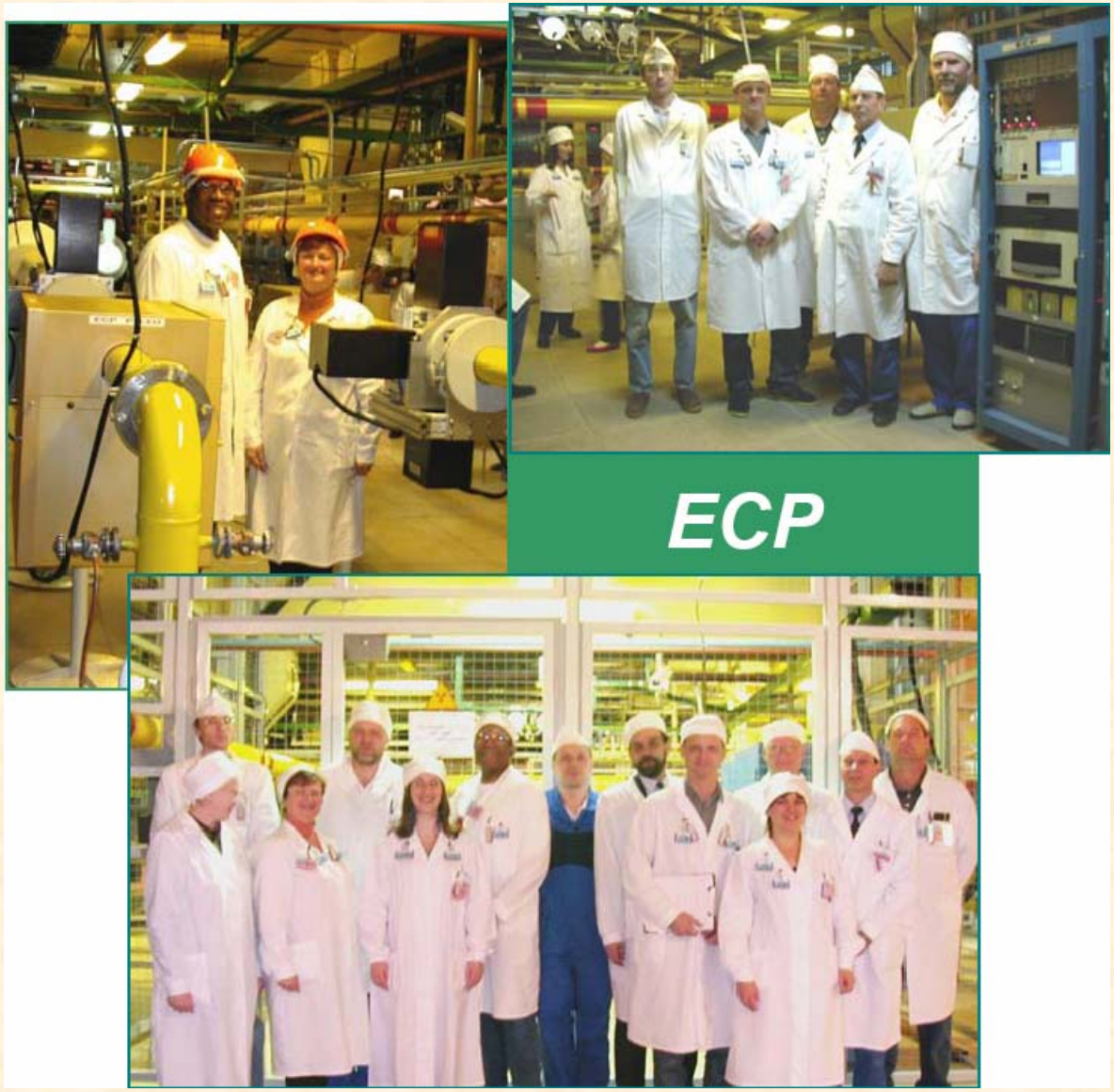
Model-Calculated Profiles Match Demo Data: Two Pressures, Similar Velocity



Model-Calculated Profiles Match Demo Data: Laminar Flow



UEIP


ECP

Startup of BDMS equipment installation

BDMS equipment installation
Completion of the start-up
and adjustment work of the BDMS equipment

SChE

Adjustment of BDMS equipment