

**Real Time Monitoring of Selenium Species, Mercury, and
Arsenic in Coal-Fired Power Plant Wastewaters
Contract Number DE-SC0020865
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Prepared for:

National Energy Technologies Laboratory

Phase I STTR Project

Highlights to Date

- Detected the Following
 - Se – 10 ppb
 - Hg – 0.03 ppb
 - As – 6.4 ppb
- Expect to Reduce These in Our Phase II Work

Team

- Energy Research Company
- Lehigh University
- Electric Power Research Institute (Phase II)

ERCo Description

ERCo

- R&D Company founded 1991
- Laser Diagnostics
- Industrial Applications
- ERCo is at the Forefront of LIBS Technology
- Formed Joint Venture, Melt Cognition, for Commercial Sales of LIBS and AIM to Metals Industry

What We Do

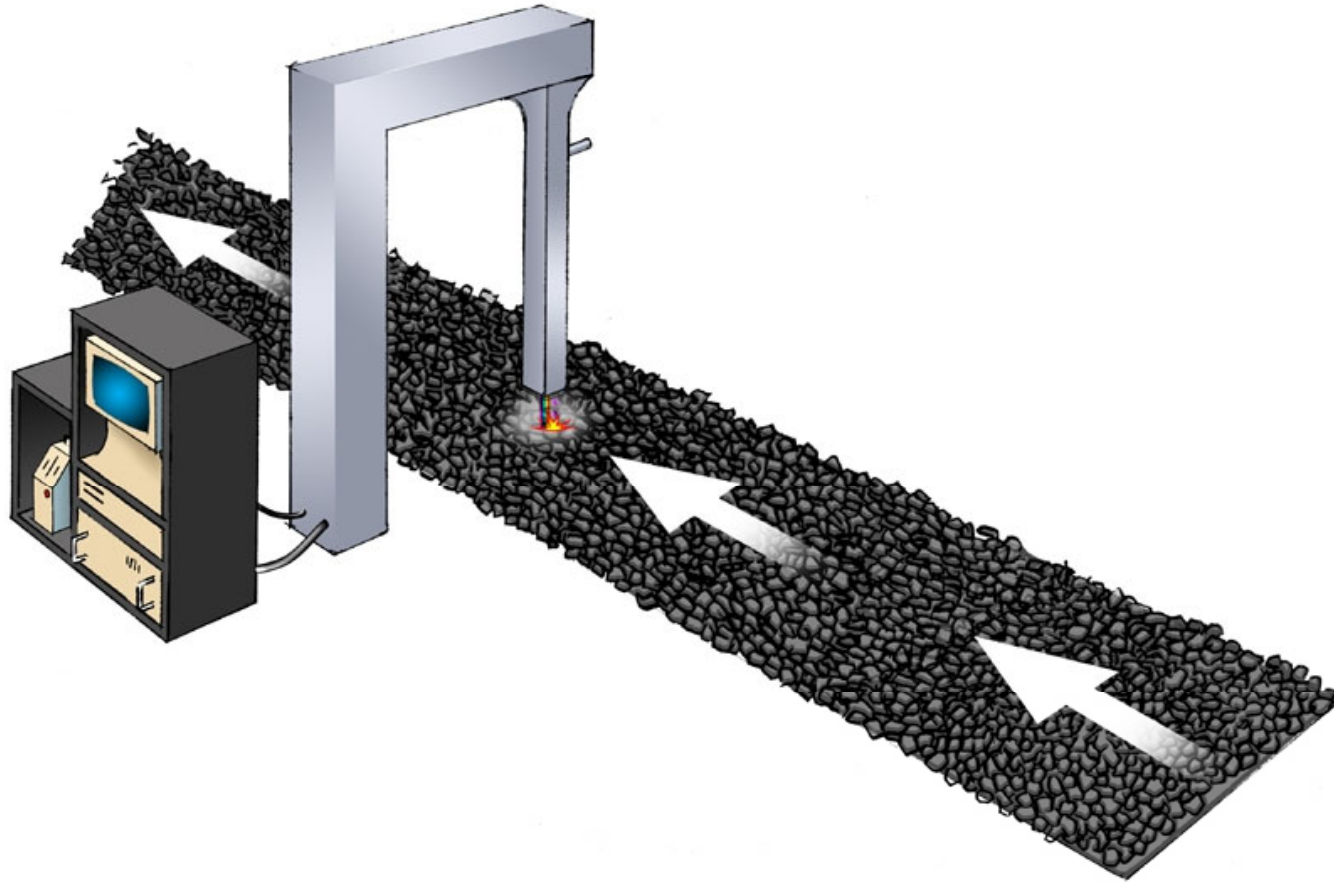
- Industrial Project Development
- Aluminum Industry
 - OnSpec
 - VFD Development
 - Aluminum Integrated Minimill
- Coal Fired Power Plants
 - LIBS for Coal Properties
- Fully Equipped Laser Spectroscopy Laboratory
- Expertise in Plasma Dynamics

Sample Projects

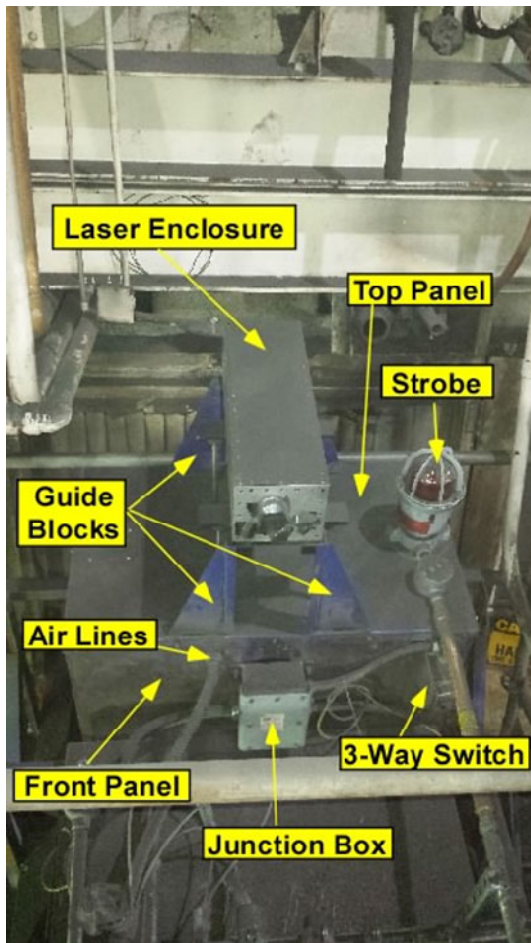
OnSpec for Molten Metals



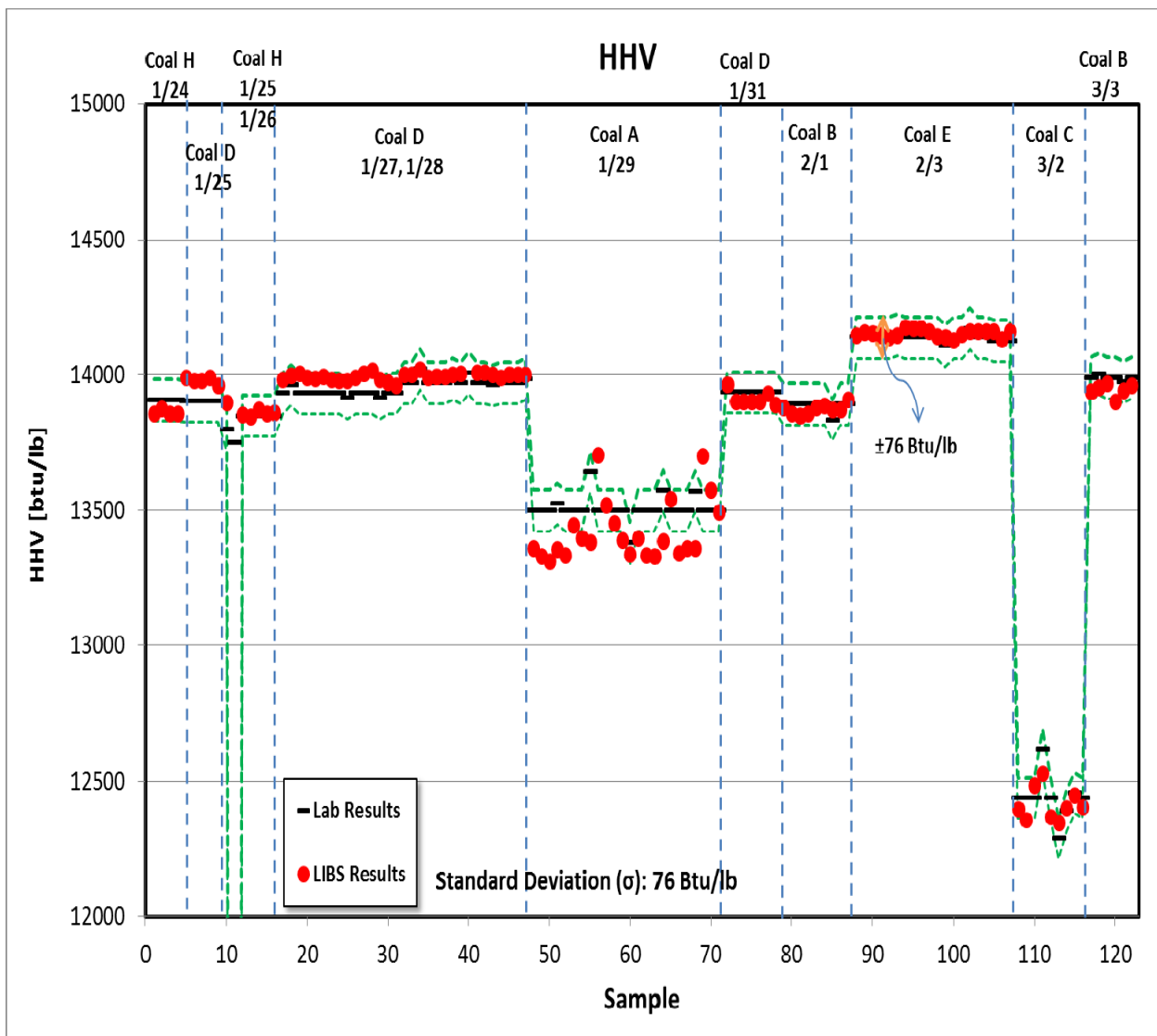
LIBS for Coal Analysis



LIBS Installation



- 2 Systems installed side-by-side over 2 conveyors
- Systems automatically detect when coal is flowing and begin measuring



OnSpec for Glass Forming Compounds

- Los Alamos National Laboratory
- Used to control the vitrification of nuclear waste

Lehigh University – Energy Research Center



- ❑ Established in 1972, the ERC main focus has been on fossil-fuel electric power generation.
- ❑ Involved In Both Fundamental and Applied Energy Research.
- ❑ Current Program Orientation: Power Generation, Energy Efficiency, Emissions Reduction, Renewable Energy, Carbon Capture, Cross-Cutting Technologies, Water-Energy Nexus, Energy Storage.
- ❑ Name branded in the power industry and with aligned funding agencies.
- ❑ Research Funding Sources:
 - *Electric Utility Companies, Organizations*
 - *Equipment Manufacturers*
 - *U.S. Department of Energy (DOE)*
 - *U.S. Environmental Protection Agency (EPA)*
 - *International Organizations*

Instrument and Business Objectives

- Measure the following in near real time and in-situ
 - Se (IV)
 - Se (VI)
 - Total Se
 - Hg
 - As
- Meet Current and Proposed EPA Regulations
- Clean Up Wastewater Sufficiently to Minimize Instrument Maintenance.
- Application – Wastewaters
 - Coal Fired Power Plant Wastewater
 - Industrial Wastewater
 - Drinking Water

Summary of the Final Rule: VIP

- VIP for FGD Wastewater Direct Dischargers
 - Technology Basis: Membrane Filtration Systems
 - Limitations:

Pollutant or pollutant property	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Arsenic, total (ug/L)	5	NA
Mercury, total (ng/L)	23	10
Selenium, total (ug/L)	10	NA
Nitrate/nitrite as N (mg/L)	2.0	1.2
Bromide (mg/L)	0.2	NA
TDS (mg/L)	306	149

Summary of the Final Rule: FGD

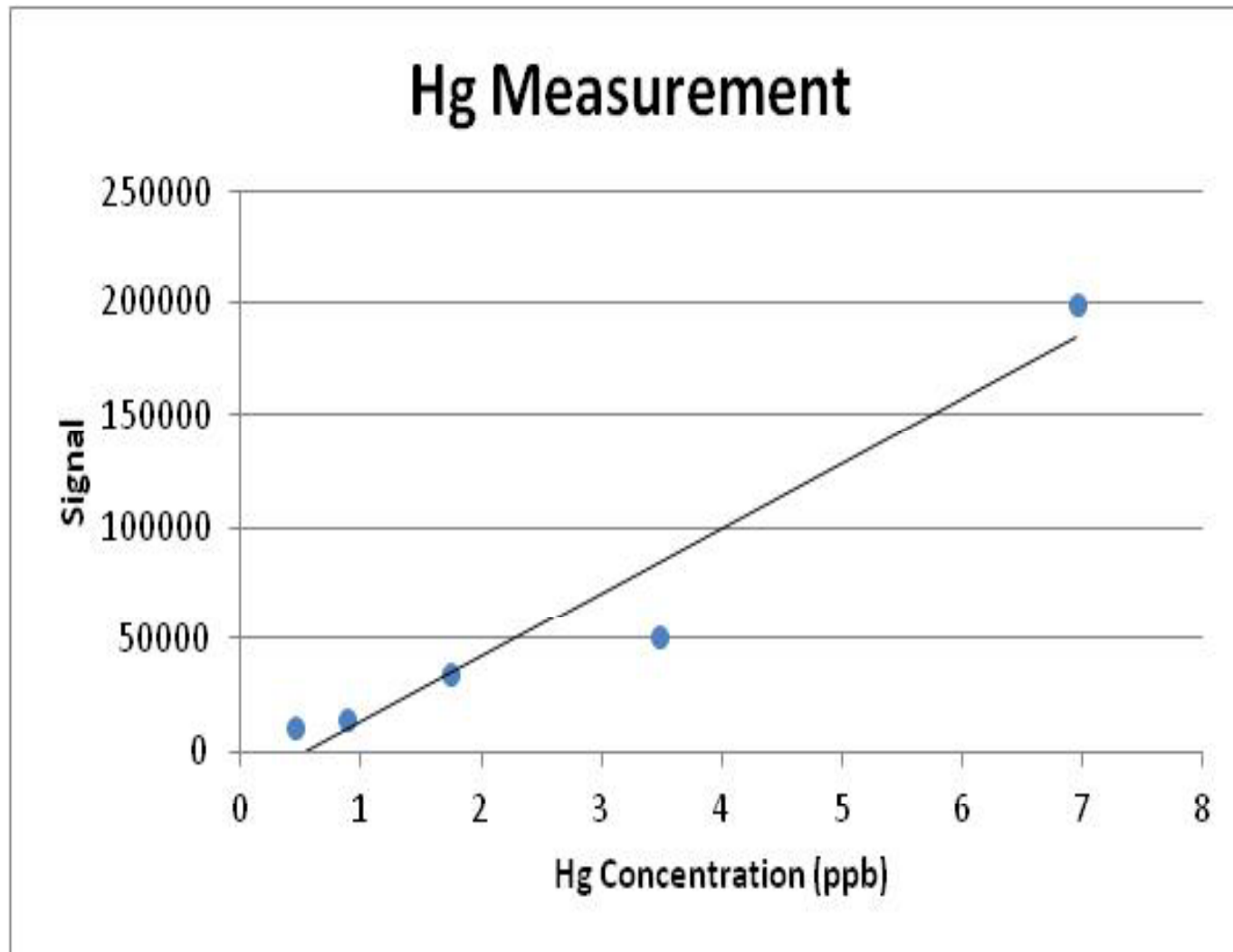
- FGD Wastewater BAT/PSES
 - BAT – Best Available Technology Economically Achievable
 - PSES Pretreatment Standards for Existing Sources
- *Technology Basis*: Chemical Precipitation (CP) followed by **L**ow Hydraulic **R**esidence **T**ime Biological **R**eduction (LRTR)
- *Limitations*:

Pollutant or pollutant property	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Arsenic, total (ug/L)	18	8
Mercury, total (ng/L)	103	34
Selenium, total (ug/L)	70	29
Nitrate/nitrite as N (mg/L)	4	3

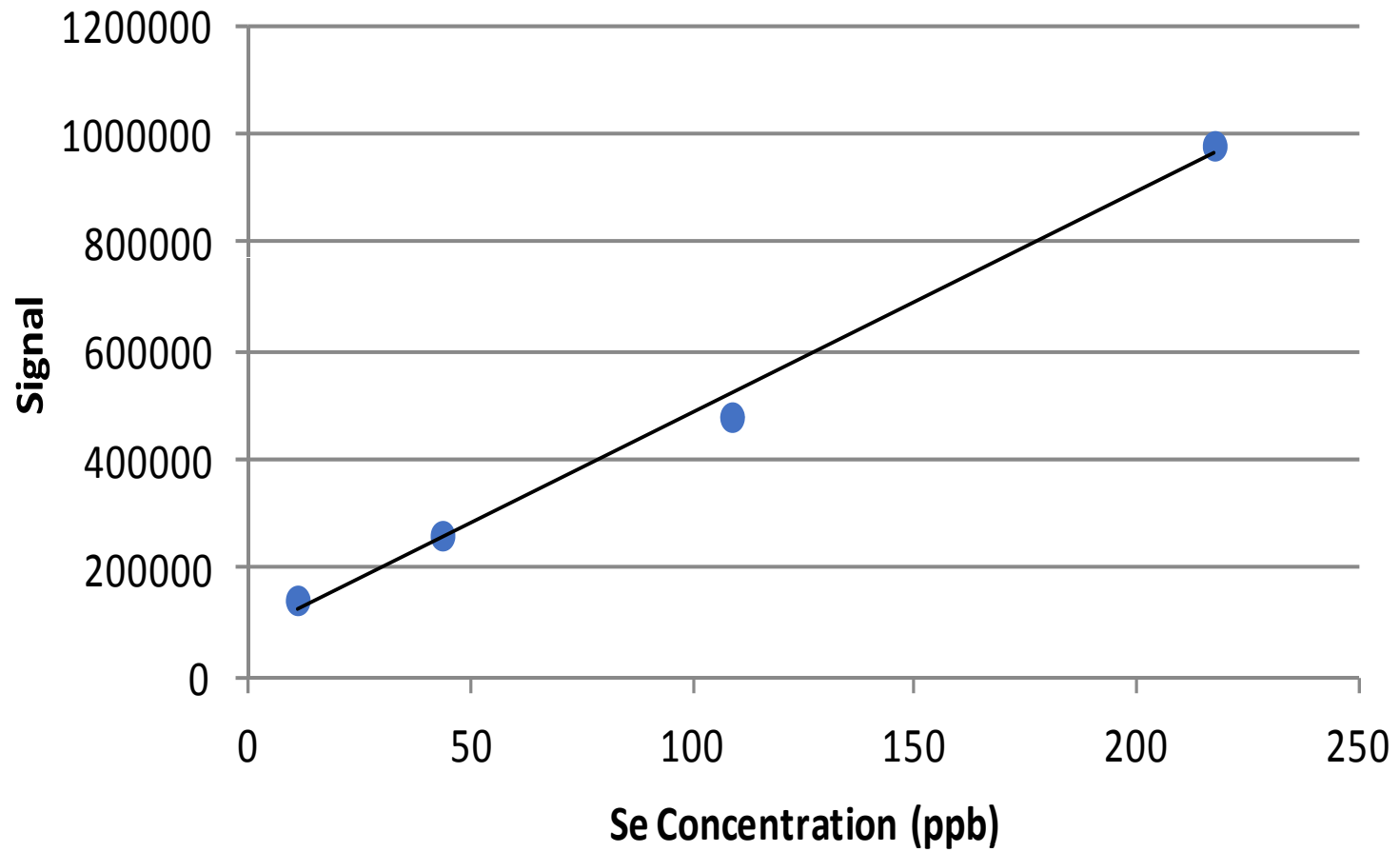
Experimental Results

	Achieved Measurement (ppb)	Achieved Concentration	Actual Limits of Detection (ppb)
As	250	39	6.4
Hg	1	36	0.028
Se	250	23	10.0

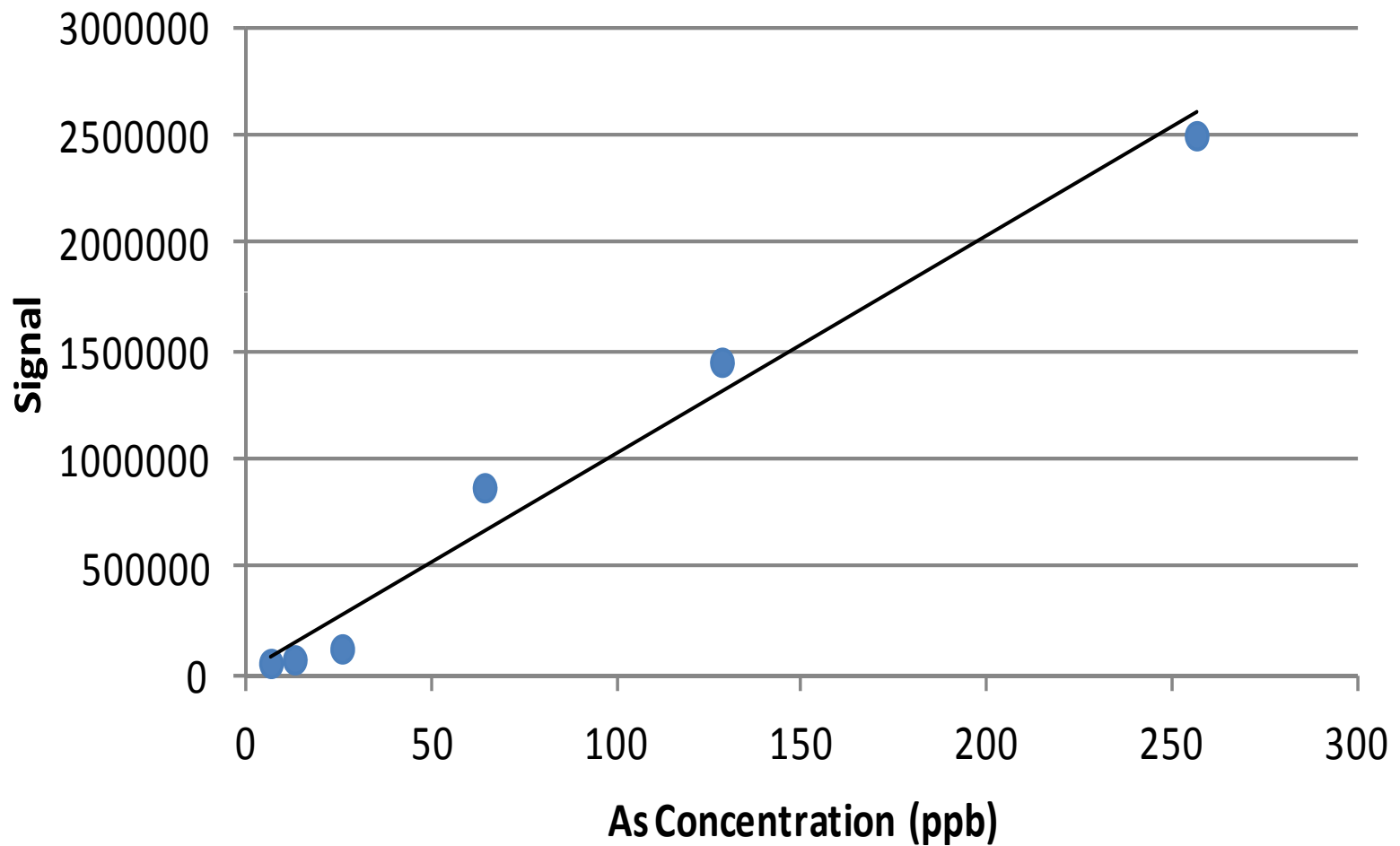
Hg Measurement



Selenium Calibration



Arsenic Calibration



Acknowledgment

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