EERC Technology… Putting Research into Practice

# Mercury Control Technology R&D Program Review

## Enhancing Carbon Reactivity for Mercury Control in Coal-Fired Power Plants – Antelope Valley Station

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DOE COR: Lynn Brickett

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# Members of the Lignite-Based Consortium

North Dakota Industrial Commission

THE NORTH AMERICAN COAL CORPORATION

Westmoreland Coal

# Technologies and Test Sites

- Sorbent injection and enhancement additives
  - **Leland Olds Station Unit 1 (ESP)**
  - **Antelope Valley Station Unit 1 (SDA)**
- Injection of impregnated and advanced sorbents
  - Stanton Station Unit 1 (ESP)
  - **Stanton Station Unit 10 (SDA)**

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# General Site Information

| Plant | Coal | Boiler Type | Boiler Size[1], MW | Particulate Control | $SO_2$ Control |
|---|---|---|---|---|---|
| LOS1[2] | Lignite/PRB Blend | Wall fired | 220 (110) | ESP[3] SCA[4]=320 | None |
| SS10 | Freedom | Tang. fired | 60 | FF[5] | Spray dryer |
| AVS1 | Freedom | Tang. fired | 440 (220) | FF | Spray dryer |
| SS1 | Freedom | Wall fired | 140 (70) | ESP SCA=470 | None |

1 Total size of the boiler with the value in parenthesises being the test size.
2 Fires mostly ND lignite; however, periodically fires a 30% blend of PRB coal.
3 Electrostatic precipitator.
4 Specific collection area, $ft^2$/1000 afm
5 Fabric filter.

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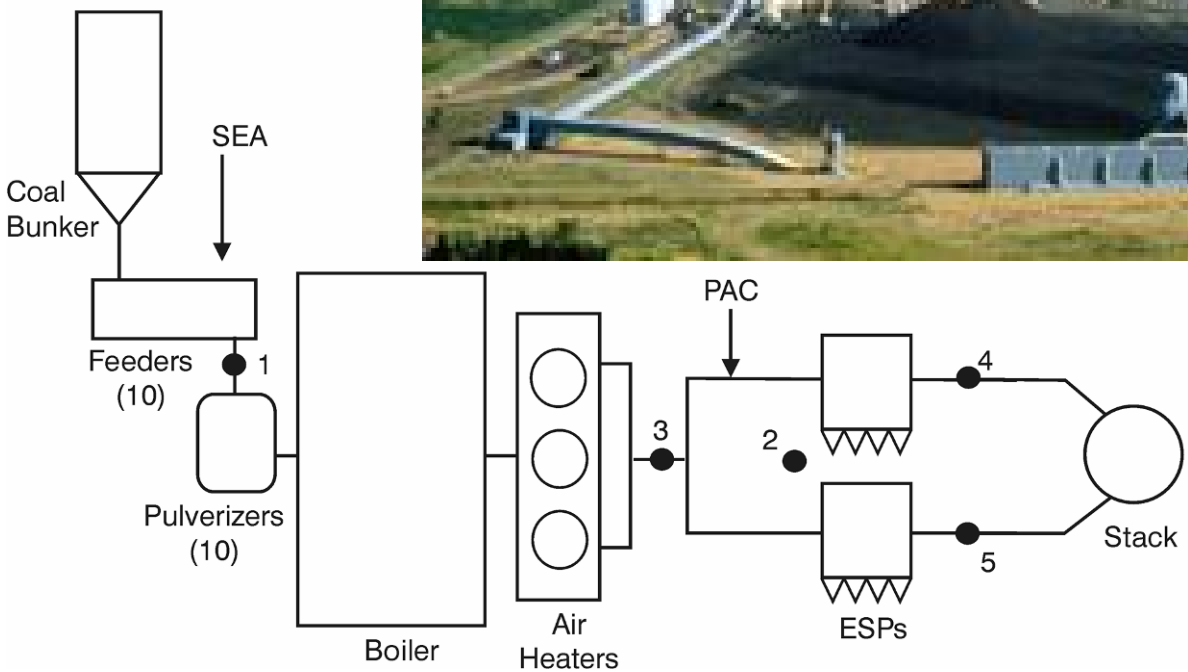
# Leland Olds Station

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# SEA Injection Skid

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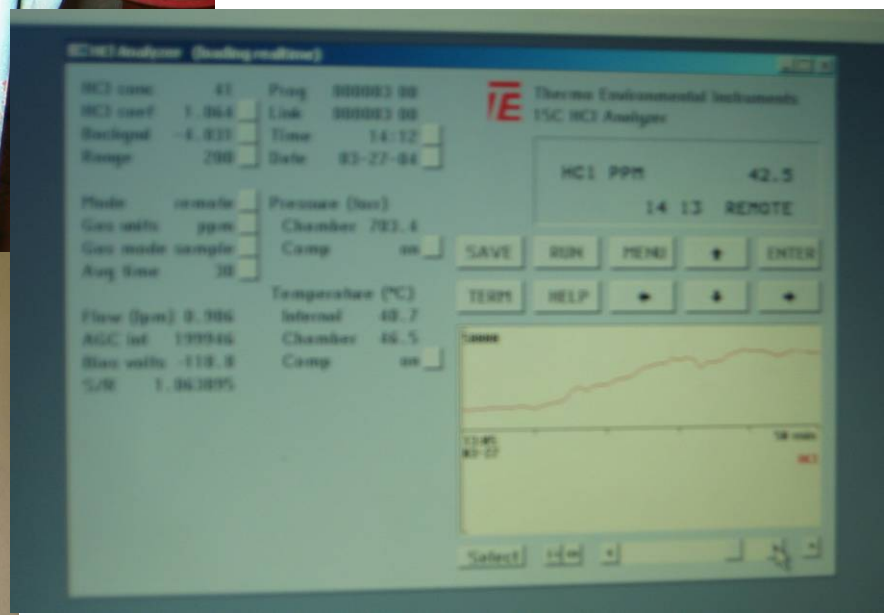
# SEA Injection Nozzle

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# PAC Storage Silo and Control Panel

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# PAC Injection Equipment

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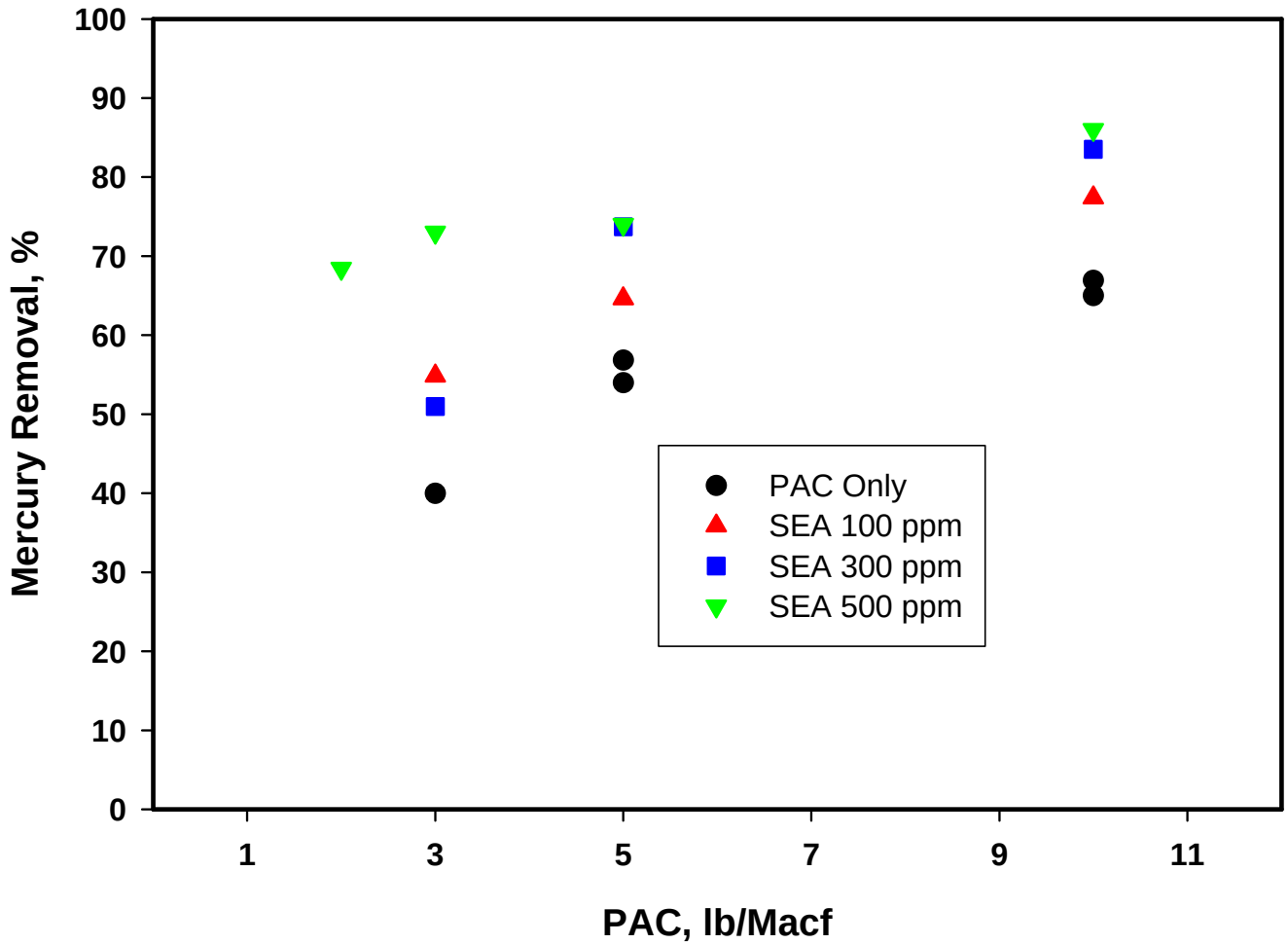
# Parametric Test Results from LOS 1

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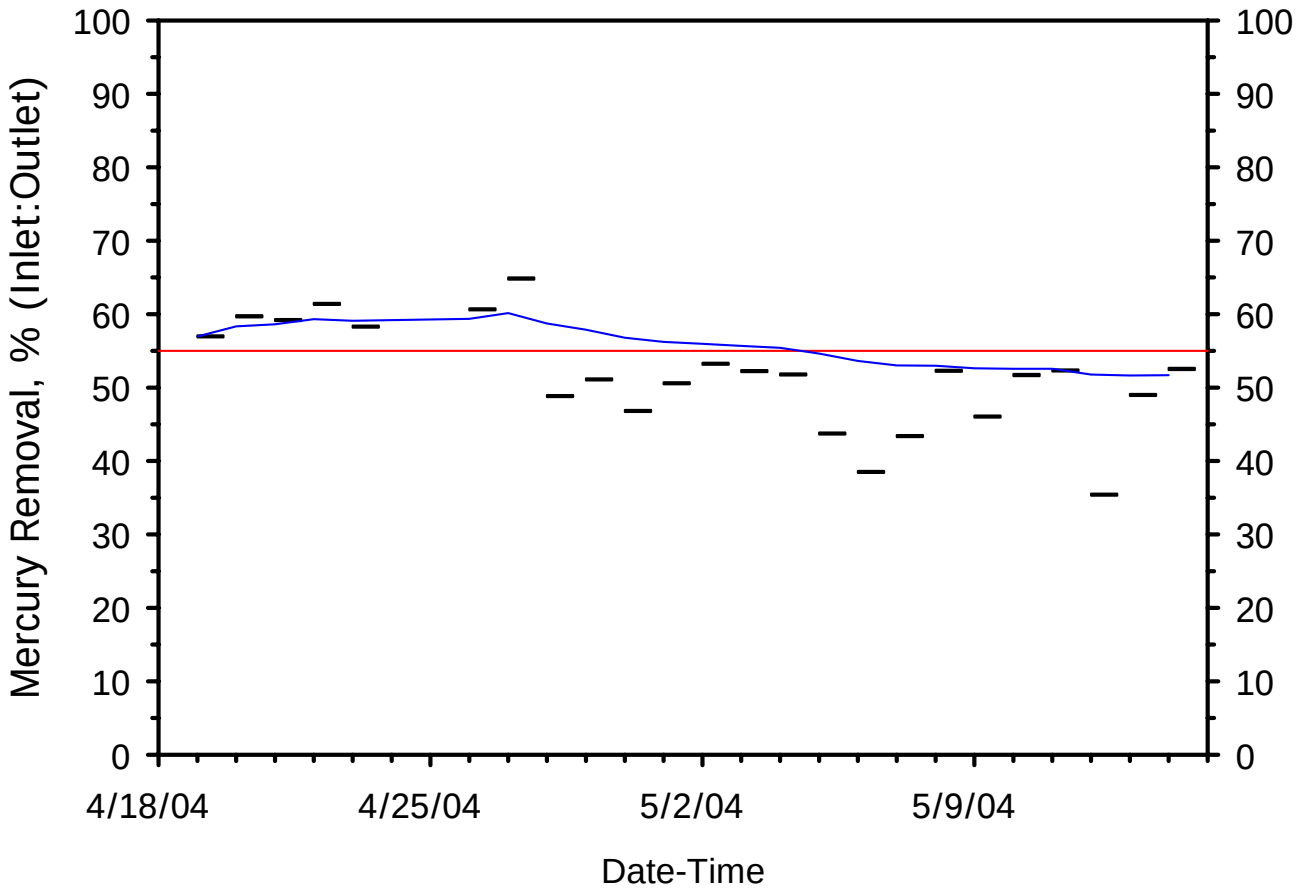
# Month-Long Test Results for LOS1

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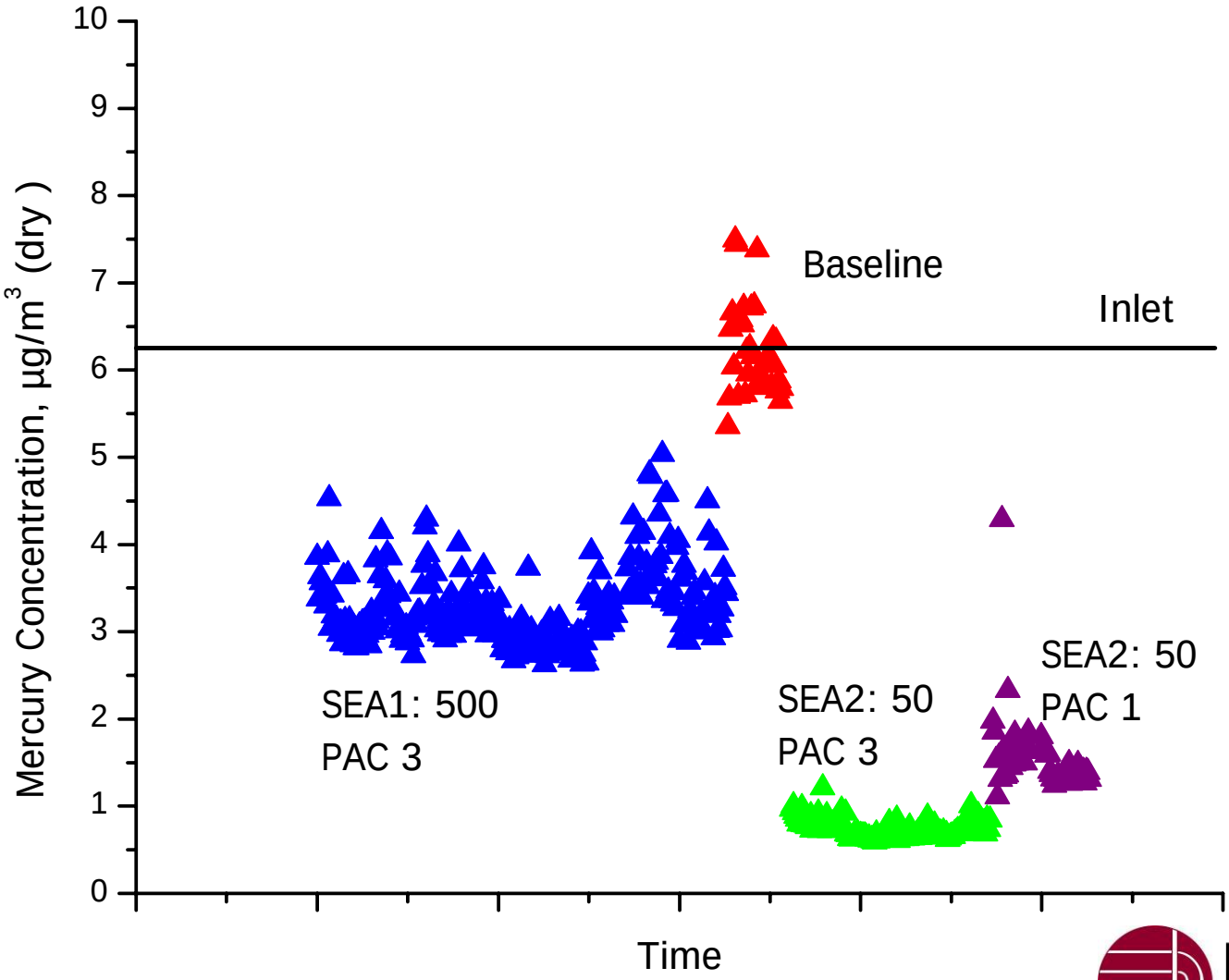
# Leland Olds Station – SEA2 Results

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# GRE Stanton Station Unit 10

- **60-MW CE tangential-fired boiler**
- **Low $NO_x$ burners**
- **Lime spray-dryer for $SO_2$ control**
- **Reverse-gas baghouse**
- **ND lignite (Freedom Mine) [0.74% sulfur, <60 ppm chlorine]**
- **>90% elemental mercury at SD inlet**

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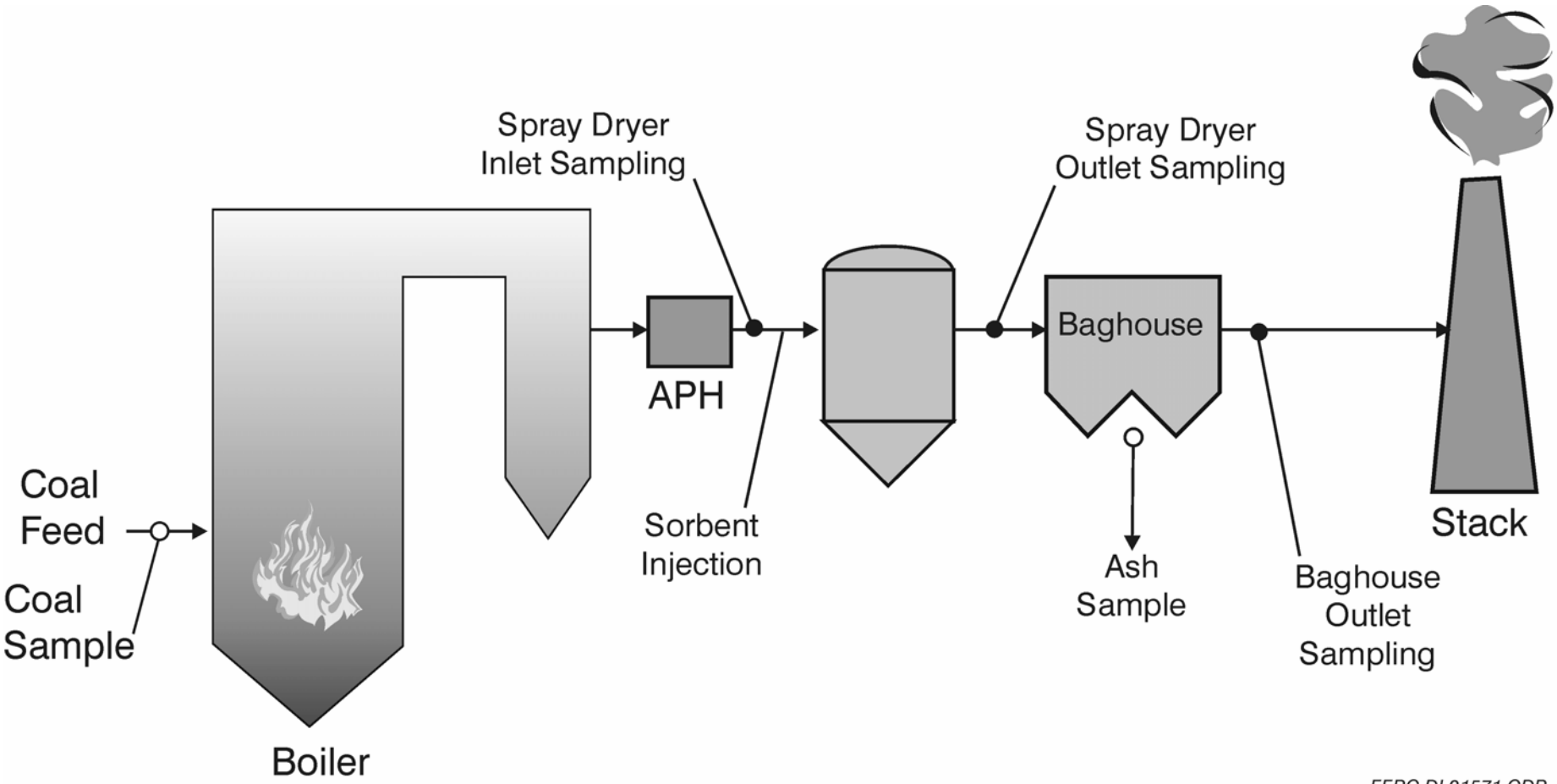
# Schematic for Stanton Station – Unit 10

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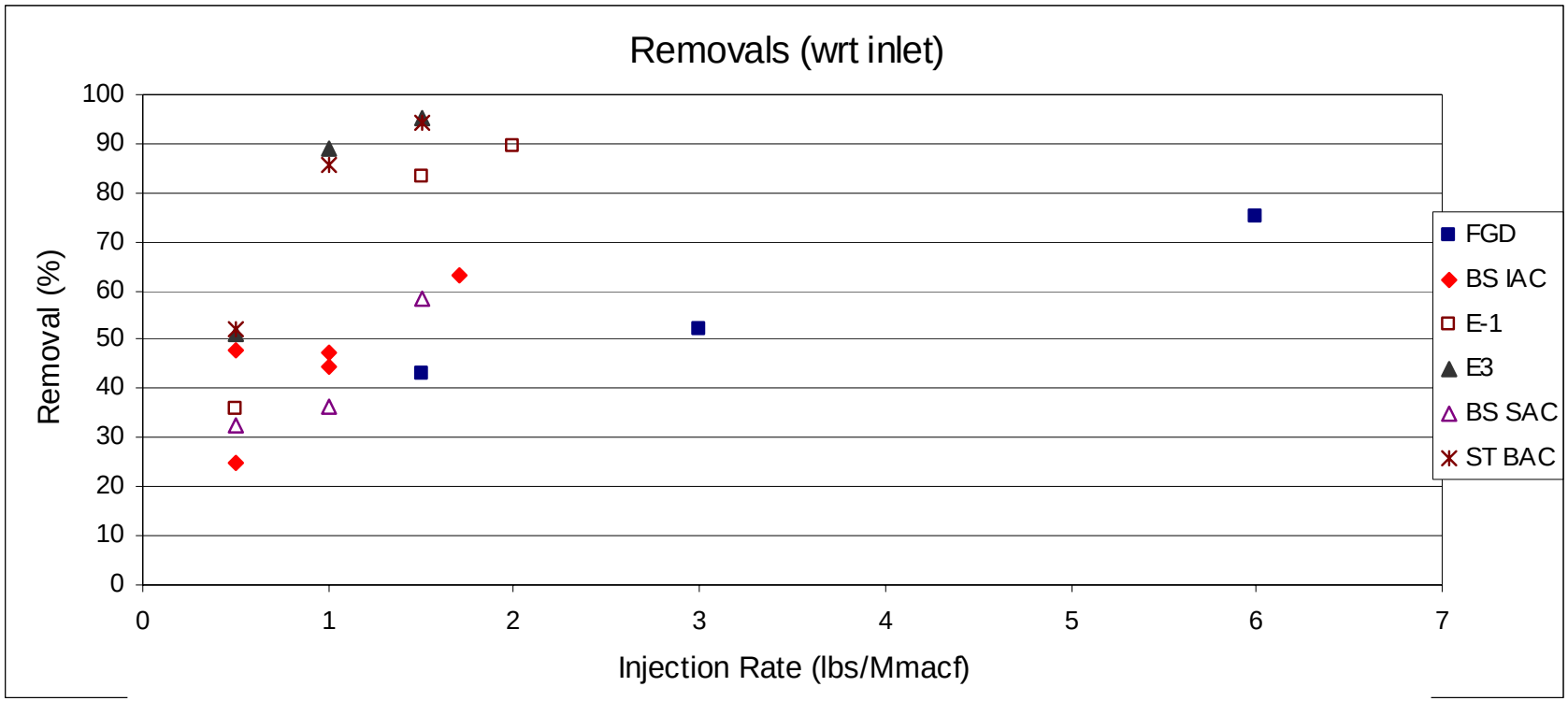
# Stanton Unit 10 Parametric Results

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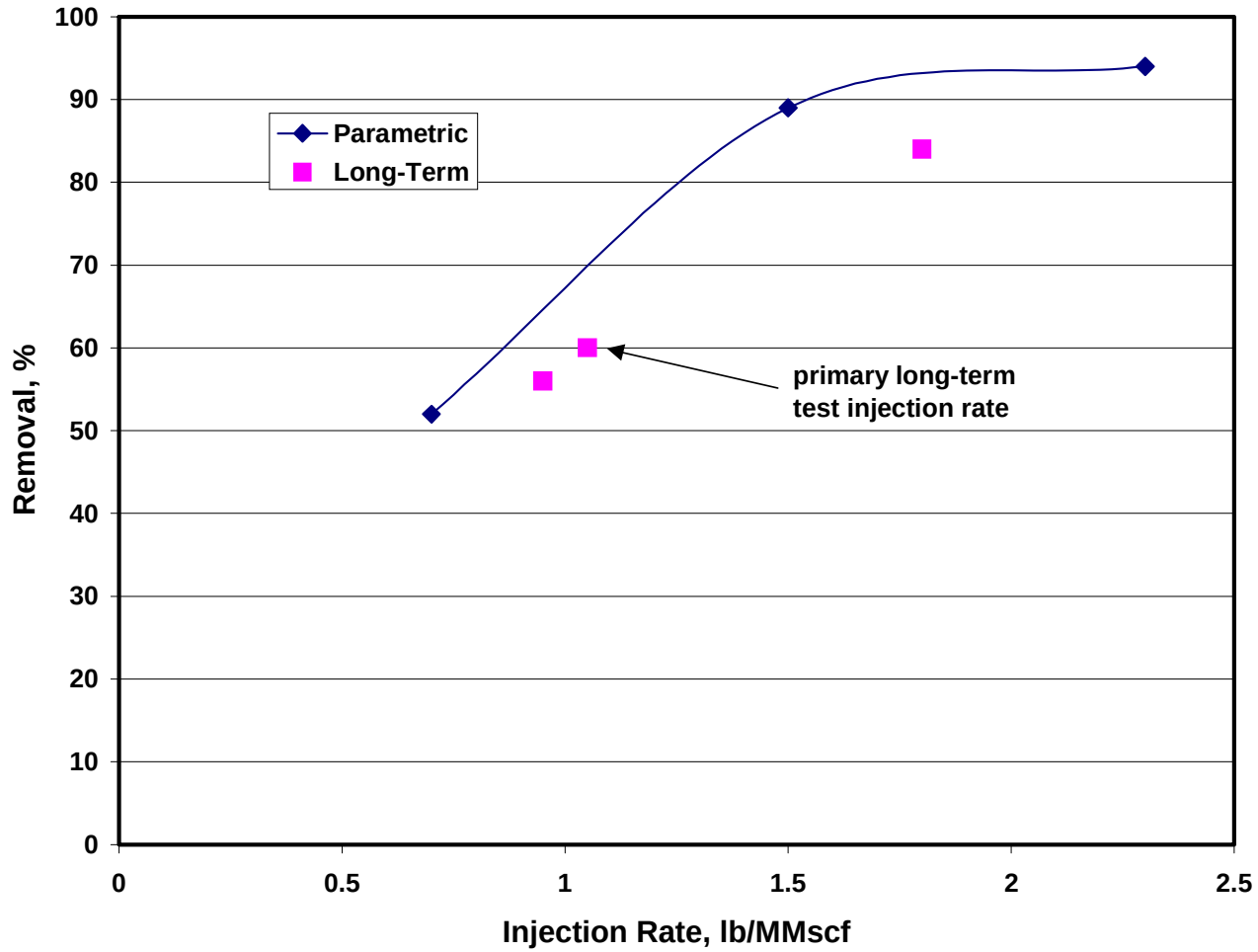
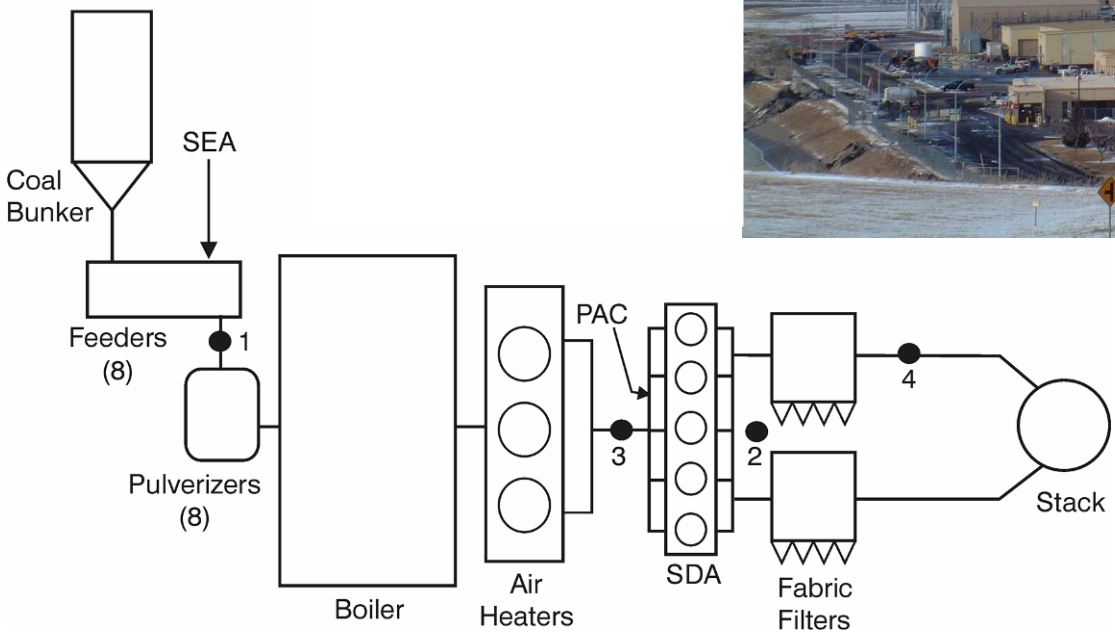
# Average Vapor-Phase Mercury Removal For Parametric and Extended Tests



# Schematic for AVS – Unit 1

- Site Lead: Chad Wocken
- SDA/FF Configuration
- 440 MW
- Freedom Lignite

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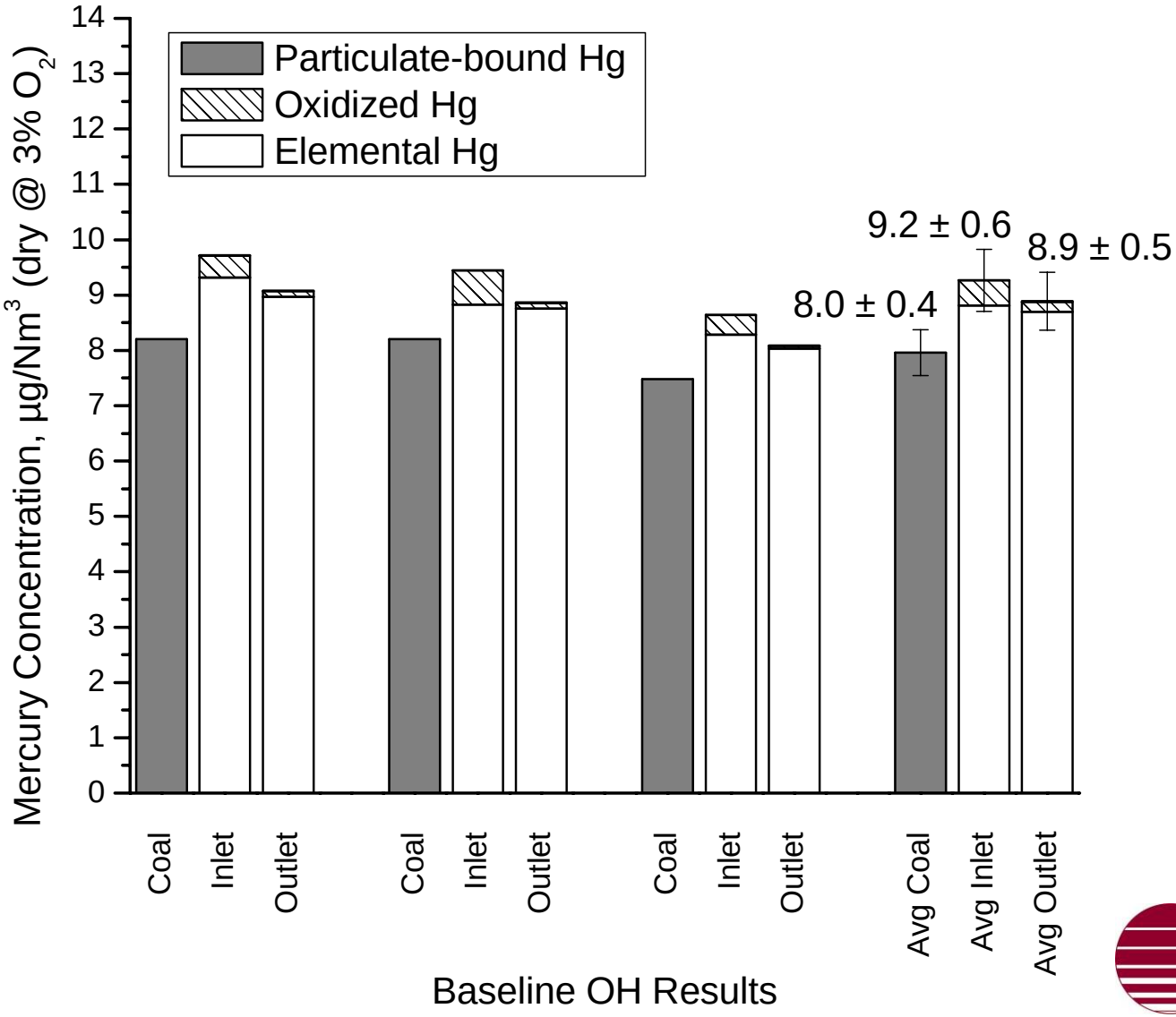
# Coal Analysis and Ontario Hydro (OH) Results – Baseline Testing

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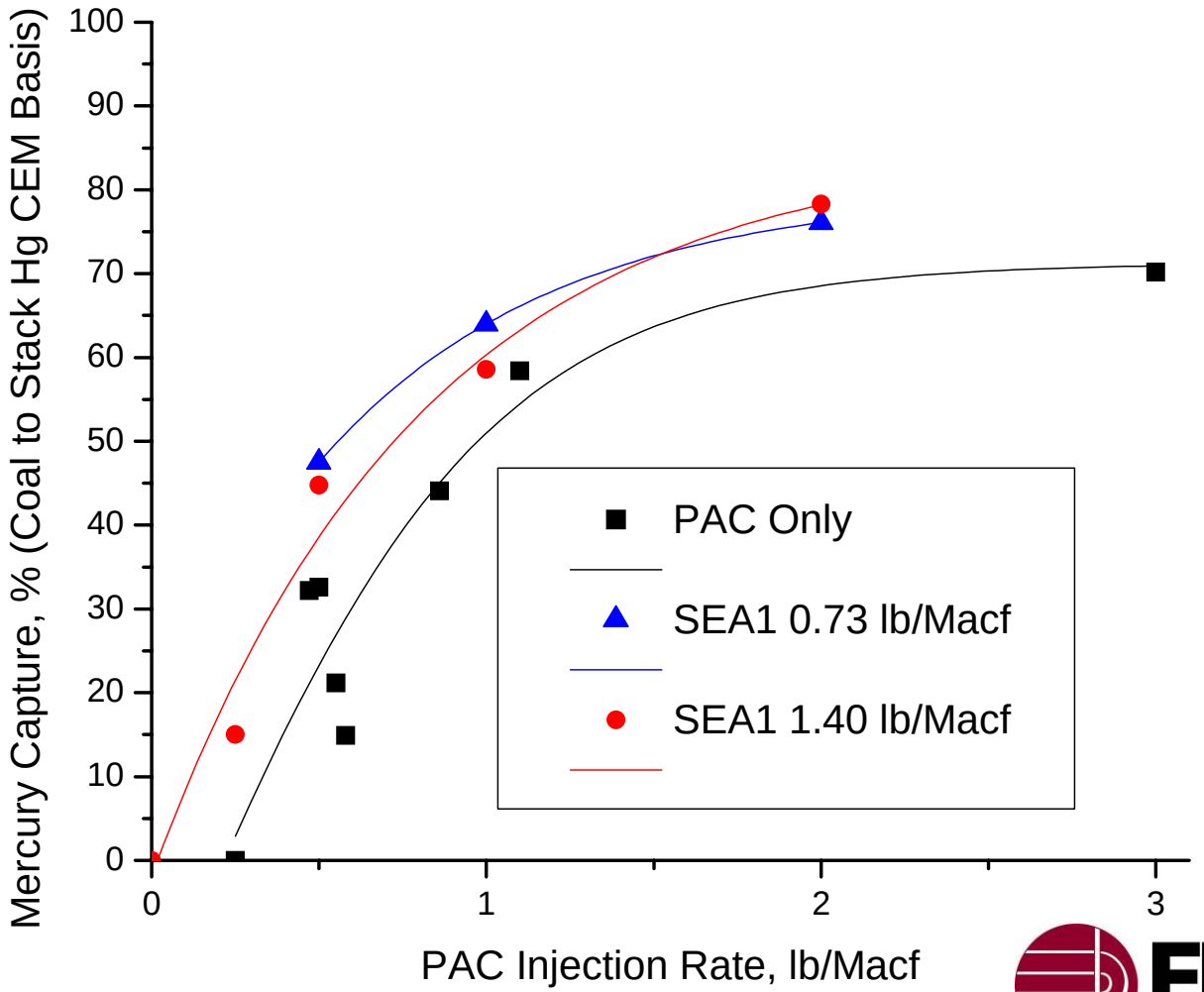
# Parametric Testing – SEA1 Addition

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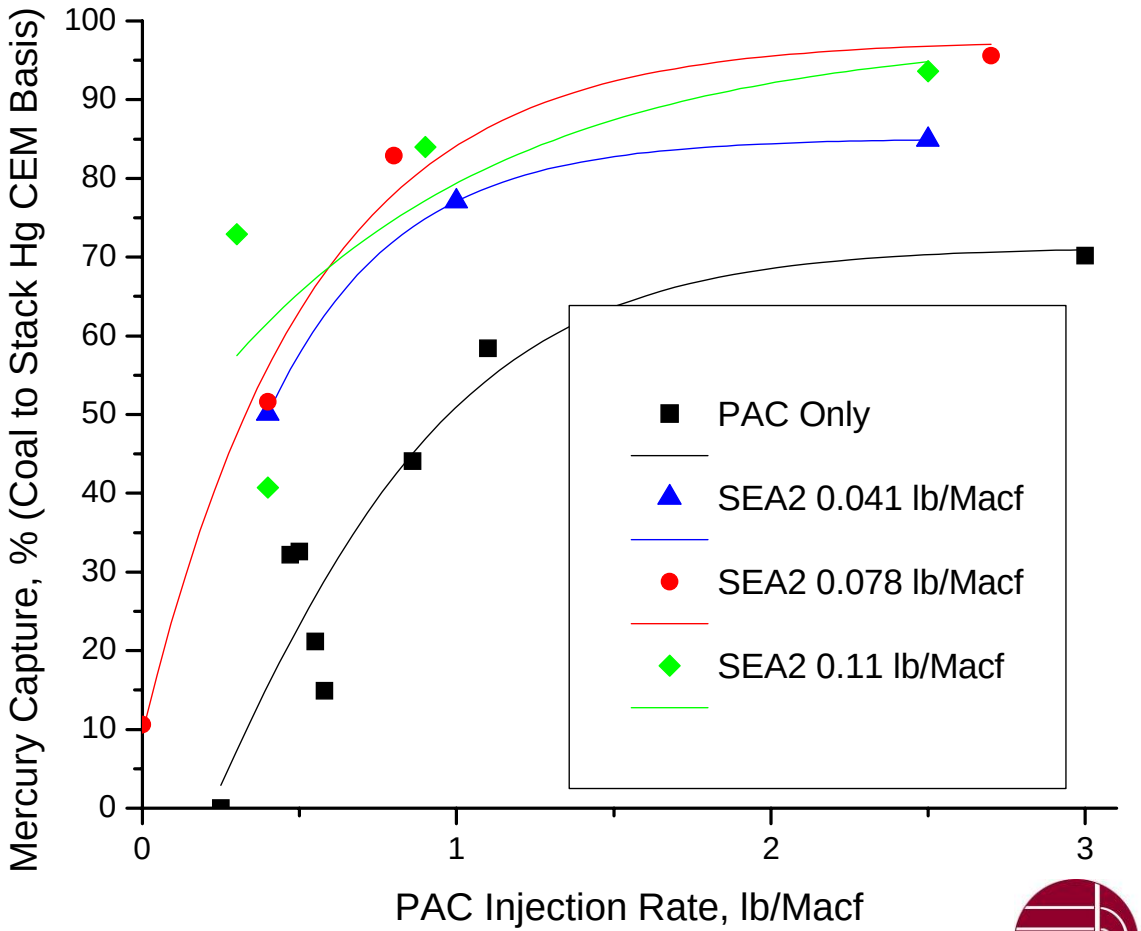
# Parametric Testing – SEA2 Addition

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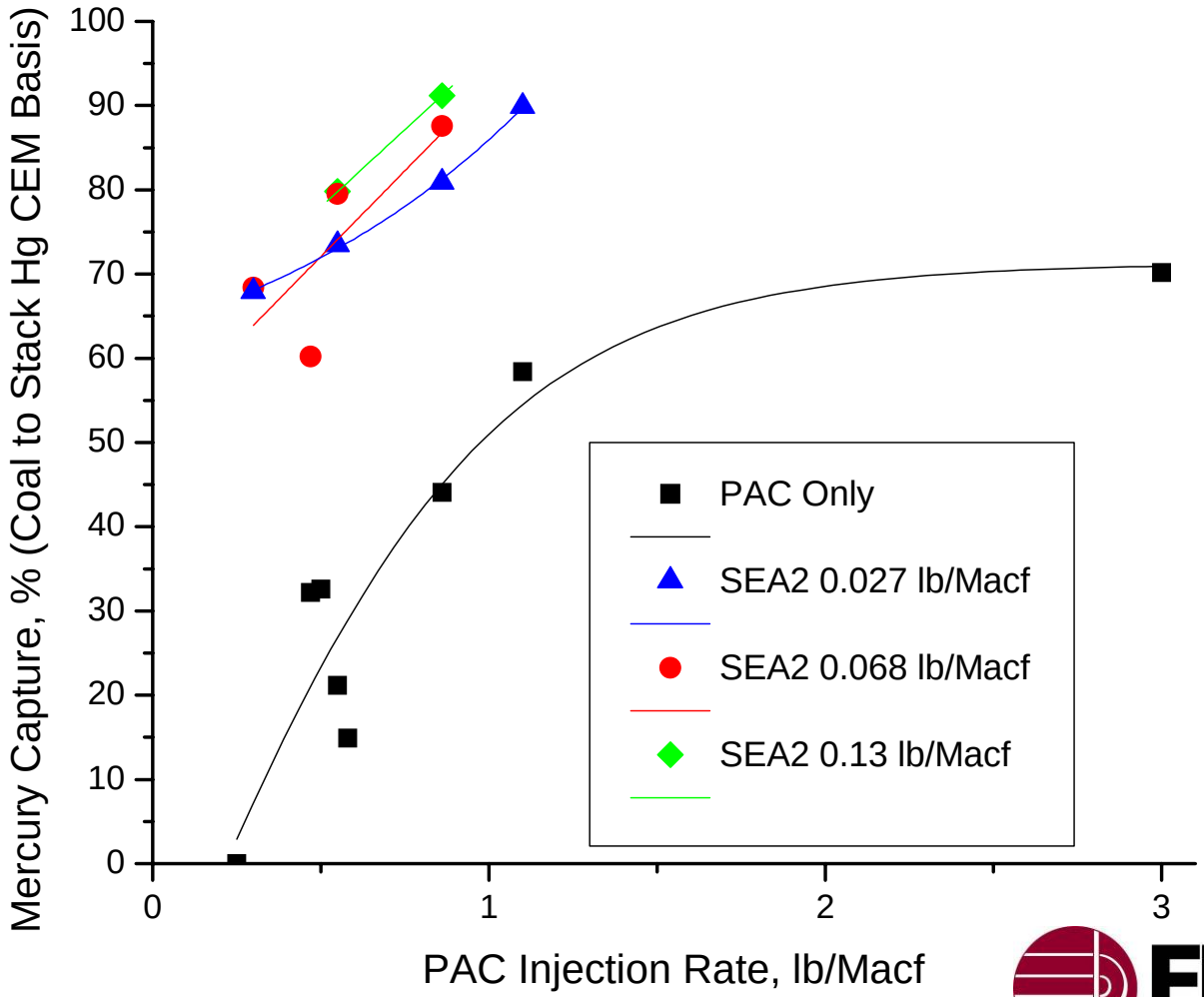
# Parametric Testing
# SEA2 Addition (Technique 2)

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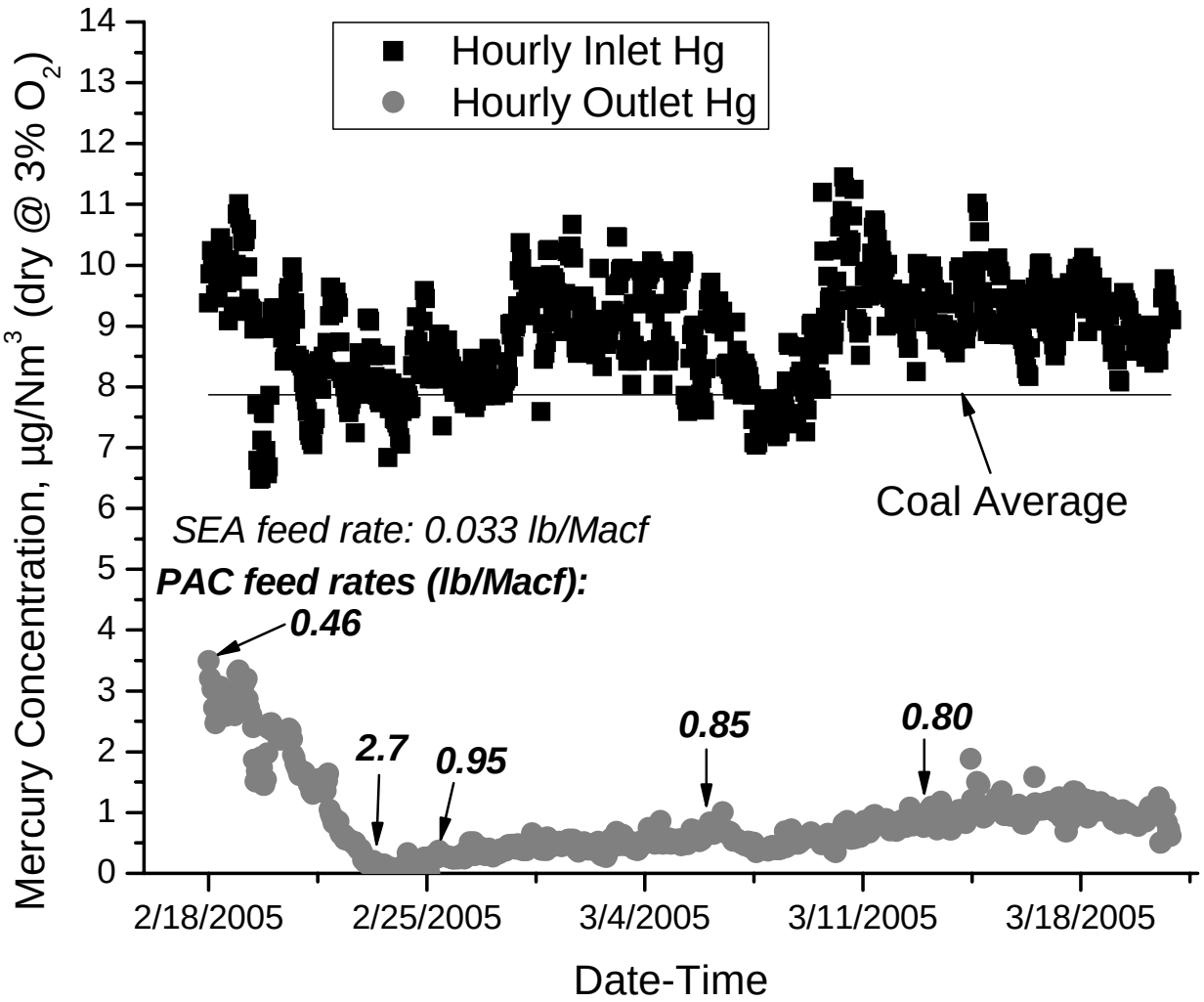
# Mercury CEM Data – Month-Long Testing (Nominal PAC = 1 lb/Macf, SEA2 0.033 lb/Macf)

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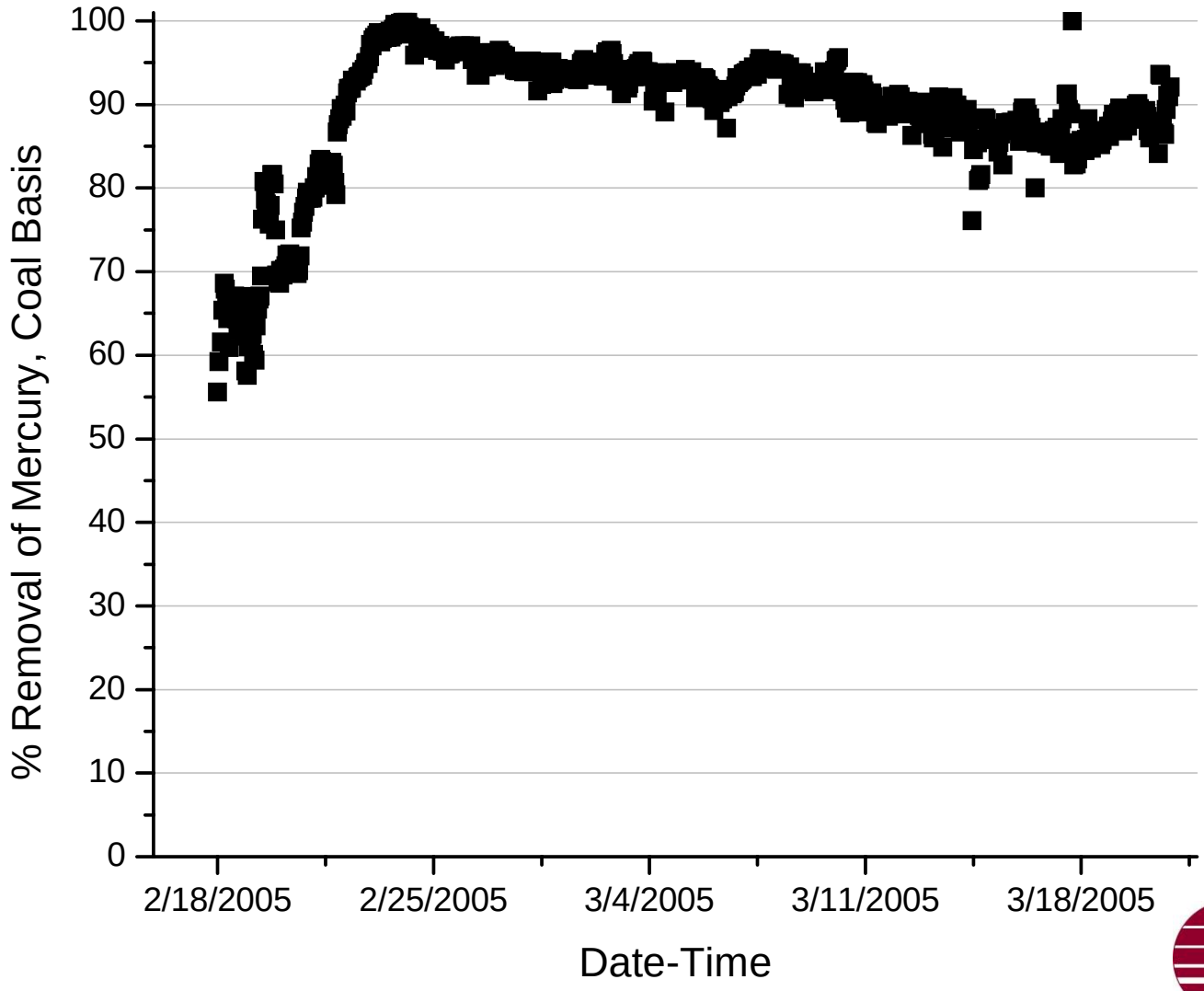
# Percent Removal of Mercury, Coal Basis – Month-Long Testing

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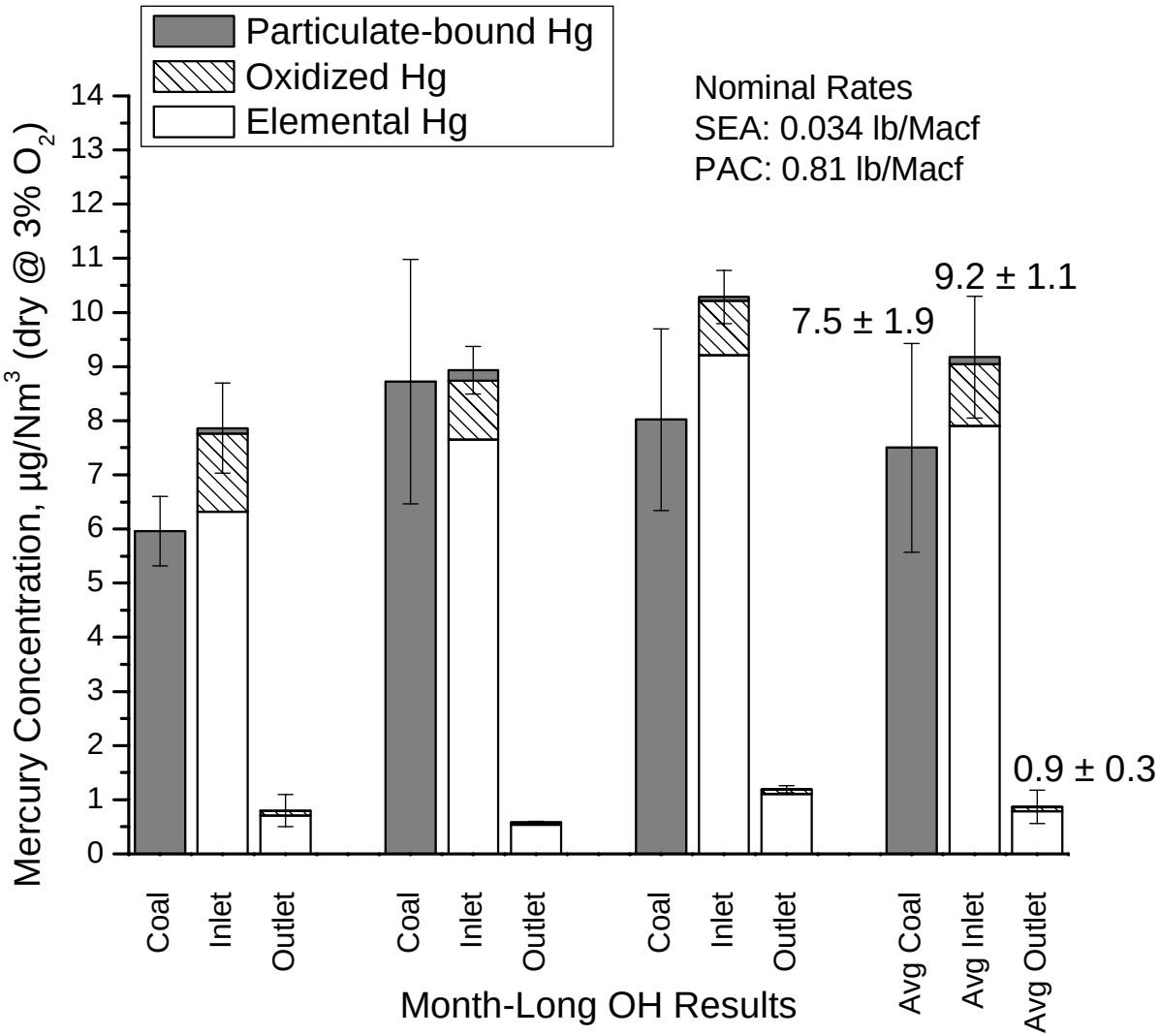
# Coal Analysis and OH Results – Month-Long Testing

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# AVS Coal Analysis

| ***Proximate Analysis, as received*** | | *Avg.* | St. | Max. | Min. |
|---|---|---|---|---|---|
| Moisture | % | 20.10 | 1.31 | 24.50 | 18.10 |
| Volatile Matter | % | 31.48 | 1.27 | 33.99 | 29.86 |
| Fixed Carbon | % | 37.47 | 1.13 | 39.70 | 34.72 |
| Ash | % | 10.95 | 1.16 | 13.15 | 7.70 |
| ***Ultimate Analysis, as received*** | | | | | |
| Hydrogen | % | 5.33 | 0.16 | 5.81 | 5.08 |
| Carbon | % | 47.27 | 1.03 | 49.14 | 44.74 |
| Nitrogen | % | 0.89 | 0.03 | 0.93 | 0.78 |
| Sulfur | % | 0.81 | 0.06 | 0.93 | 0.70 |
| Oxygen | % | 34.75 | 1.17 | 38.41 | 33.18 |
| Heating Value | Btu/lb | 7964 | 175 | 8229 | 7613 |
| Fd | dscf/$10^6$Btu | 9583 | 152 | 9935 | 9376 |
| Sulfur, dry | % | 1.02 | 0.08 | 1.17 | 0.87 |
| Heating Value, dry | Btu/lb | 9968 | 170 | 10173 | 9600 |
| Mercury, flue gas basis | µg/$Nm^3$ | 7.94 | 1.50 | 11.29 | 5.21 |
| | lb/TBtu | 5.54 | 1.03 | 7.71 | 3.63 |
| Coal sample collected from the pulverizer and therefore partially dried | | | | | |

# AVS SDA/FF Hopper Ash Mercury Concentrations

| | Baseline | | Month-long | |
|---|---|---|---|---|
| | SDA | FF | SDA | FF |
| Average, ppm | 0.0001 | 0.0004 | 0.2671 | 0.4946 |
| Std. Dev. | 0.0001 | 0.0005 | 0.0384 | 0.0553 |
| Maximum, ppm | 0.0002 | 0.0010 | 0.3582 | 0.5614 |
| Minimum, ppm | <0.0001 | <0.0001 | 0.1838 | 0.3520 |

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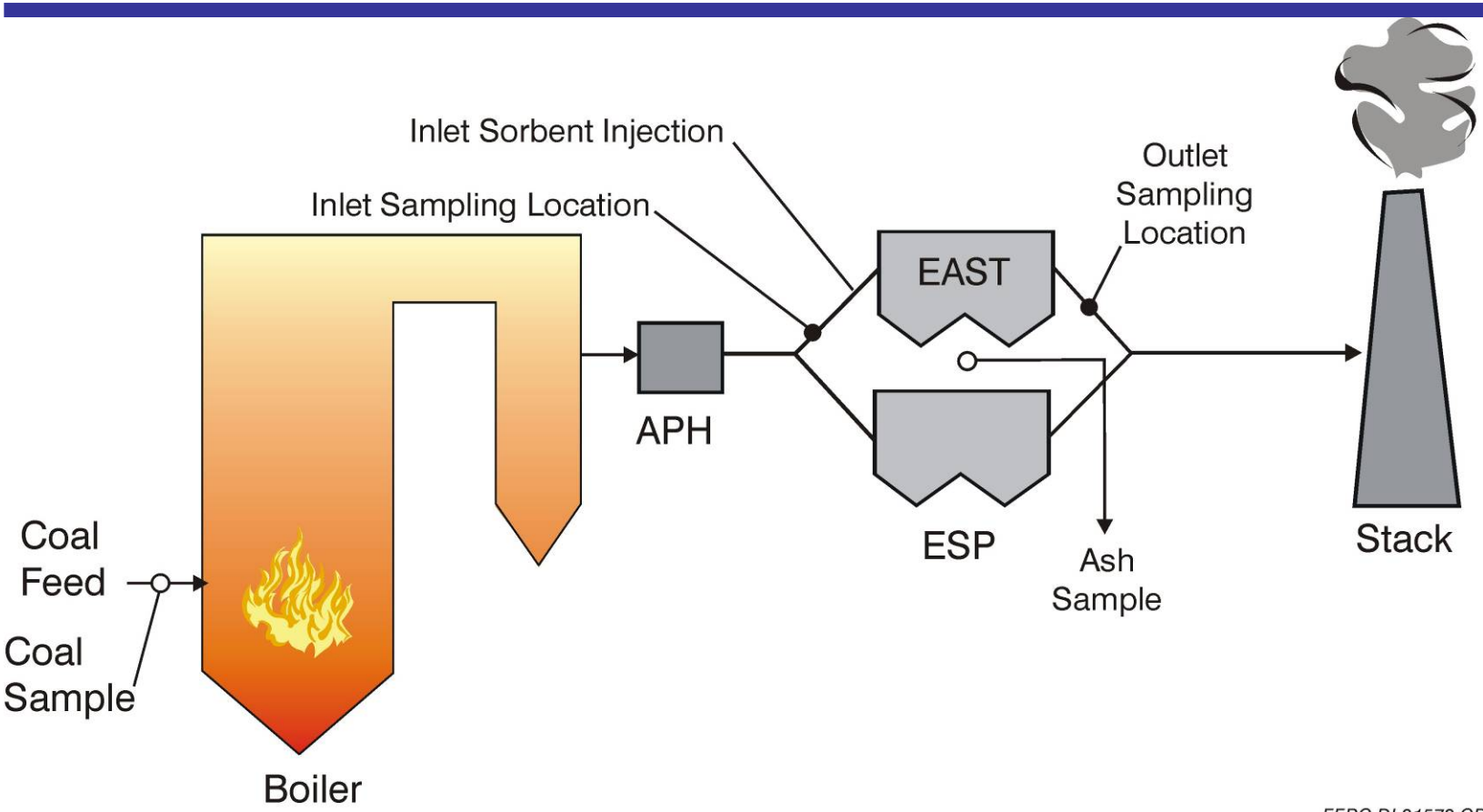
# Stanton Station Unit 1

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*Testing Scheduled for August and September by URS*

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# Balance of Plant Impacts

- Corrosion – Sample analyses underway.
- Opacity – No measurable changes.
- ESP and FF Operation – No noticeable changes.
- Pressure Drop – No measurable increases.

*Data are currently under more detailed review, Much longer operation is needed to fully characterize*

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