Real-time Corrosion Product Transport Monitoring Using On-line Particle Monitors

Joe Zimmerman
Chemtrac Systems, Inc.
Norcross, GA

CHEMTRAC

Introduction

The goal of CPT monitoring is to determine:

- when corrosion is occurring
- where corrosion is occurring
- how much corrosion is occurring

Introduction

The ability to monitor CPT in real-time will allow for:

- System control actions to be taken based on the current corrosion product levels
- Measurement of the effects of the adjustments on the corrosion product levels

Introduction

Overview

- Steam Cycle Monitoring
- Particle Detection Technology
- CPT Particle Monitoring
- Conclusions

Steam Cycle Monitoring

Steam Cycle Monitoring

Traditional Methods

- Soluble
  - *Grab sample tests*
    - **Metals analysis, various other lab analyses**
  - *On-line analyzers*
    - **Cation conductivity, sodium, silica, pH, etc.**
  - *Composite sampling*
    - **Ion exchange columns, resin-impregnated filter pads**

Steam Cycle Monitoring

Traditional Methods

- Insoluble
  - *Grab sample tests*
    - **Millipore pads, TSS, lab particle analyses**
  - *On-line analyzers*
    - **Turbidity monitors**
  - *Composite sampling*
    - **Corrosion Product Monitor filter pads**

Steam Cycle Monitoring

On-line Particle Analysis

- provides ***real-time*** indication of insoluble particulate loading
- allows for ***continuous*** data collection & trending

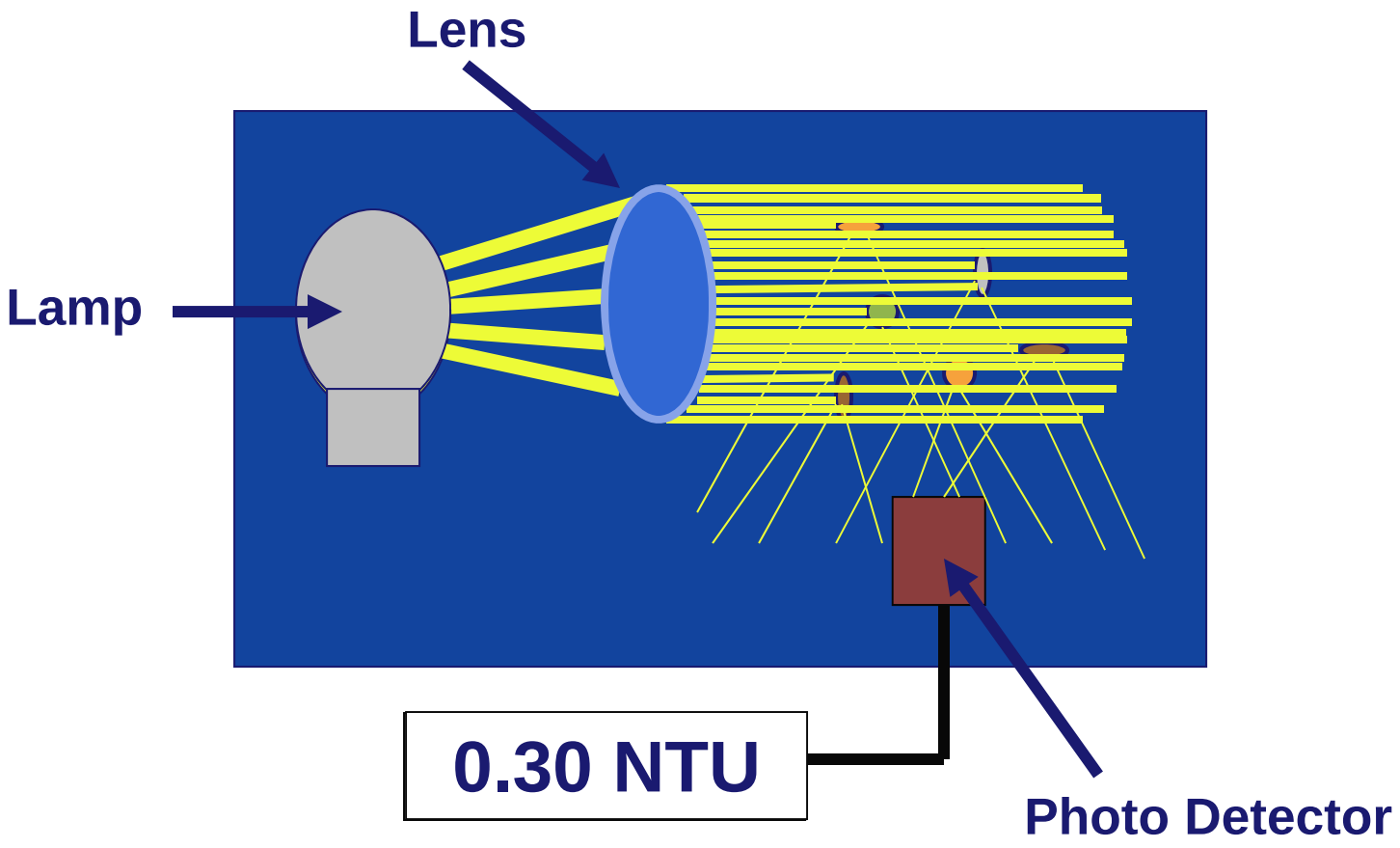
Particle Detection Technology

Particle Detection Technology

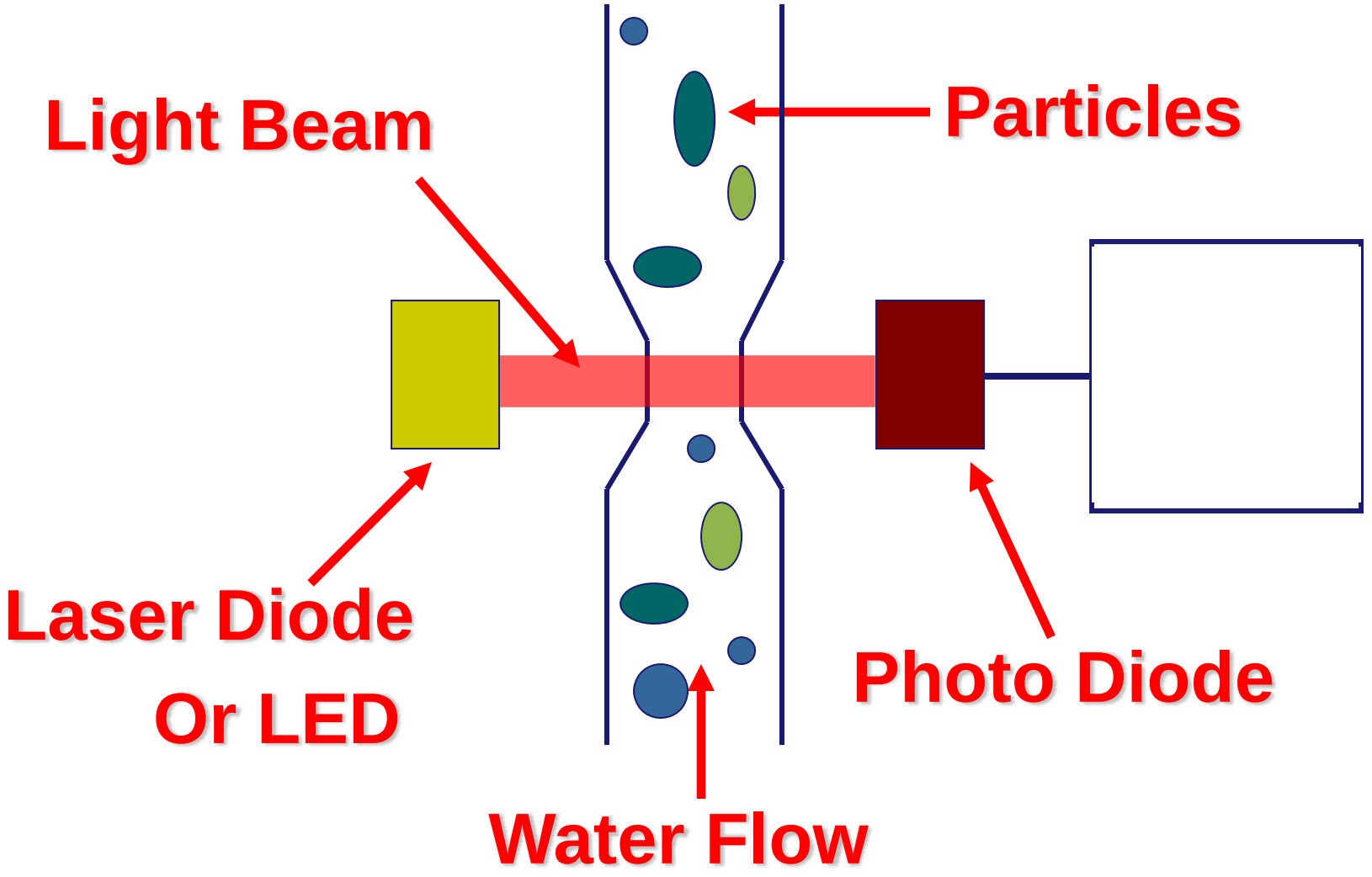
- Turbidity Monitors utilize a “light scattering” measurement
- Particle Counters & Particle Monitors utilize a “light blockage” measurement

Particle Detection Technology

Turbidity Monitor



Particle Detection Technology



Particle Detection Technology

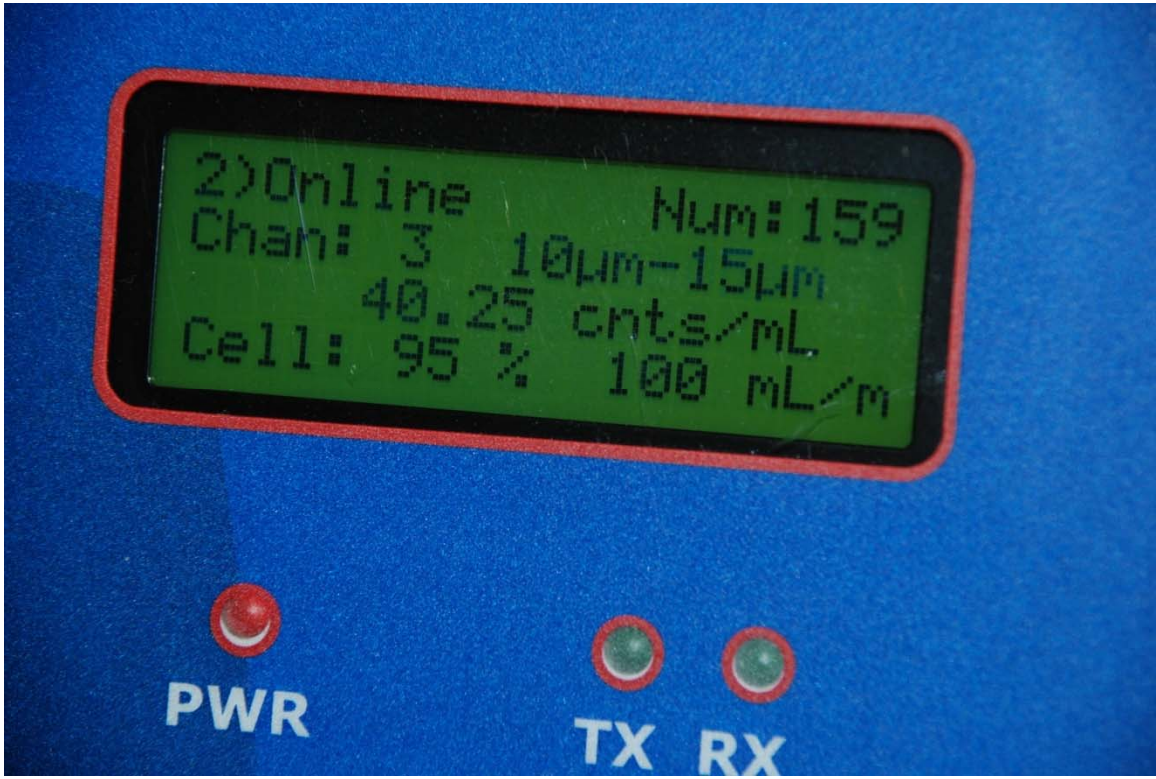
Particle Counter & Particle Monitor

- Detect particles ≥ 2 microns
- 1 particle/mL sensitivity
- <10 PPT detection capability

Particle Detection Technology

Particle Counter

- Reports results in counts/mL for up to 8 size ranges
- Allows for size/count distribution profiles



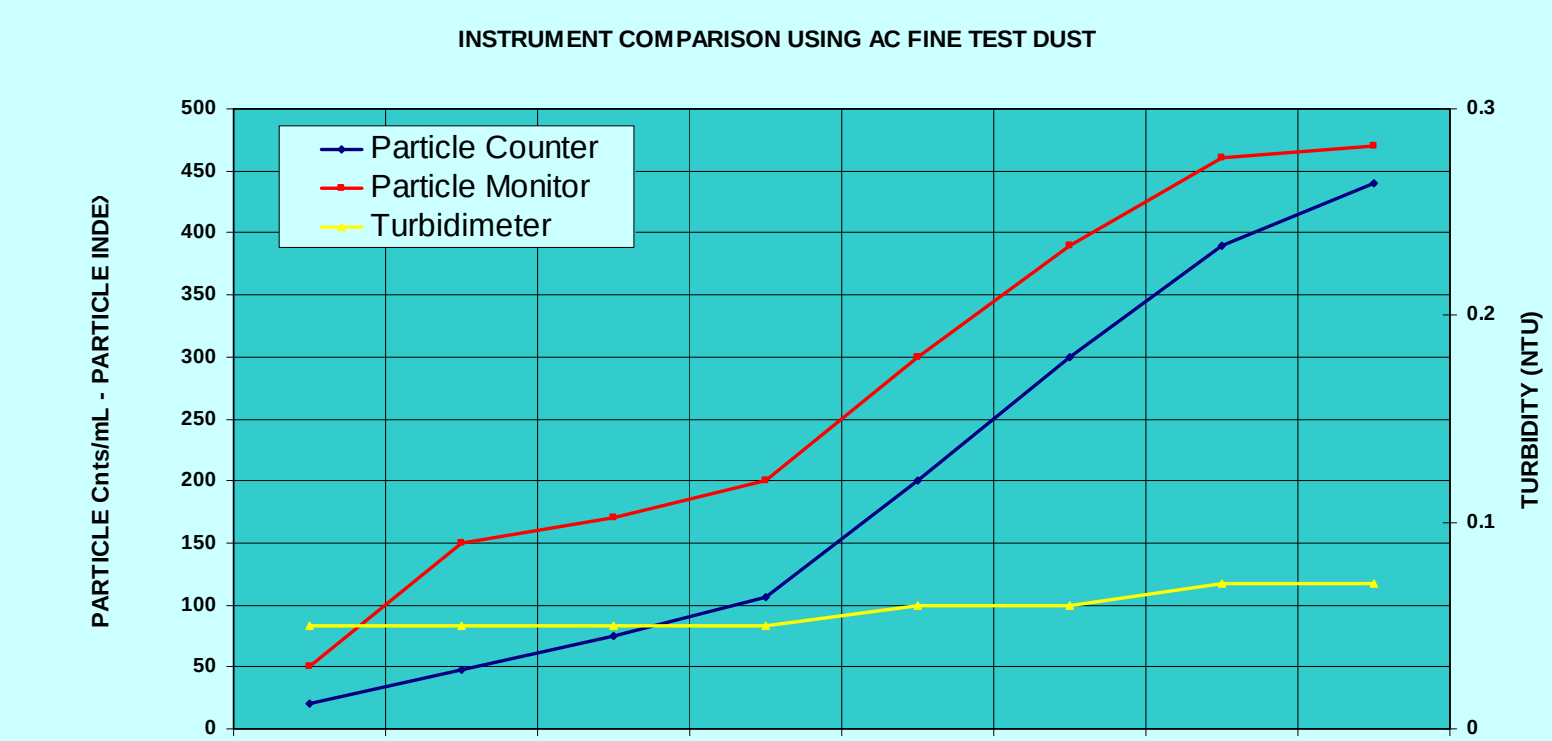
Particle Detection Technology

Particle Monitor

- Single channel device, producing a “relative” measurement called a Particle Index (PI)
- The PI will increase with both an increase in particle size and concentration

Particle Detection Technology

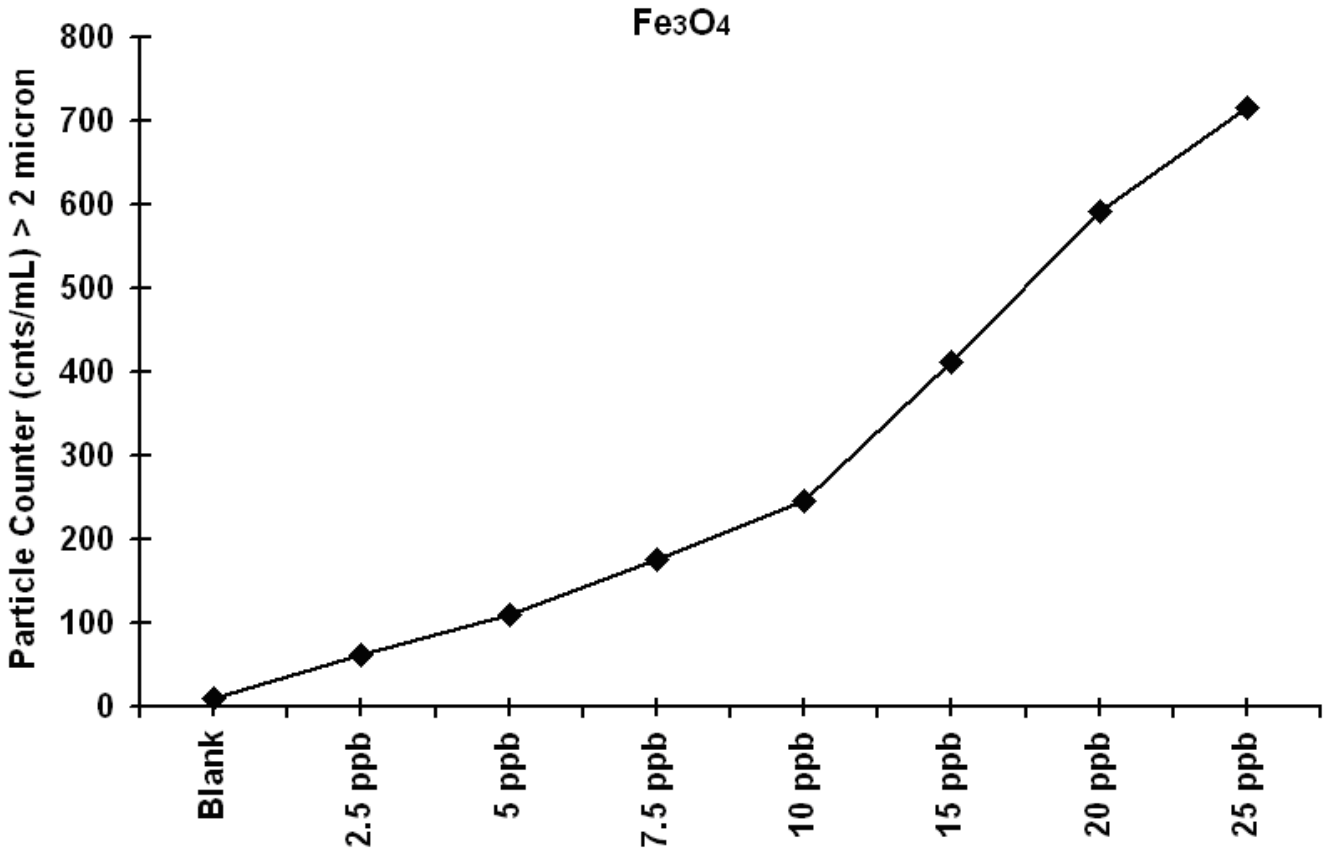
Particle Counter, Particle Monitor, Turbidity Monitor



Particle Counter	21	48	75	106	200	300	390	440
Particle Monitor	50	150	170	200	300	390	460	470
Turbidimeter	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07

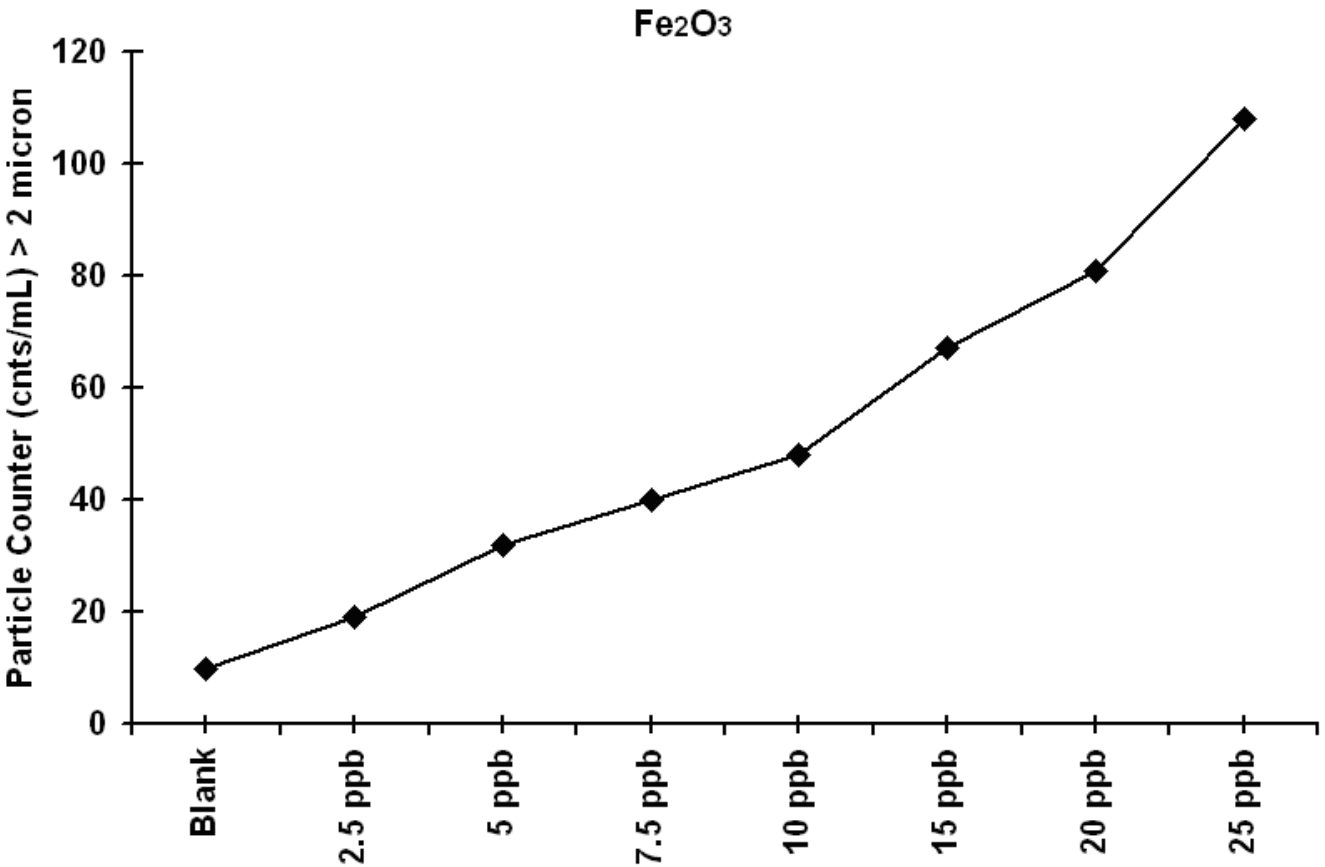
Particle Detection Technology

Magnetite



Particle Detection Technology

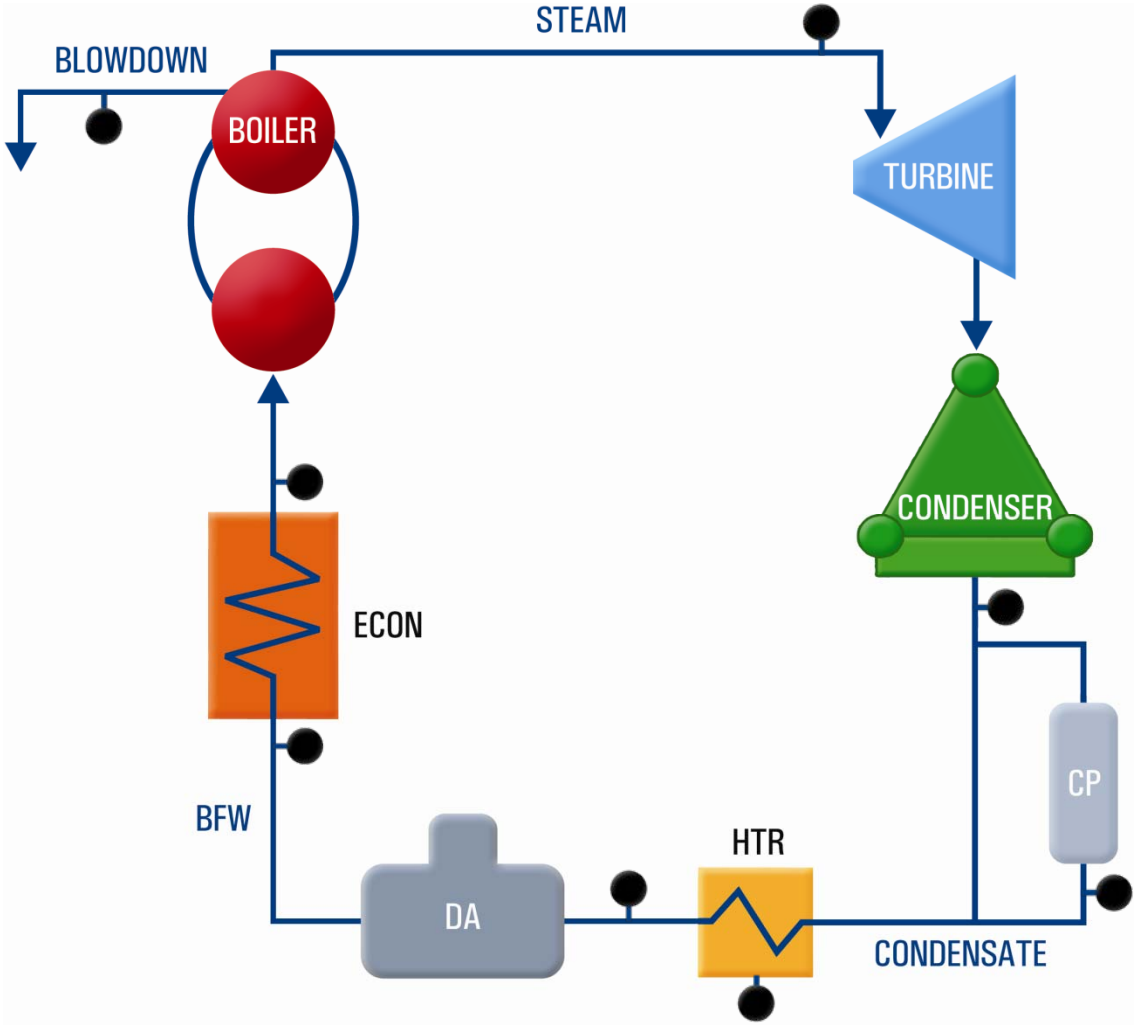
Hematite



CPT Particle Monitoring

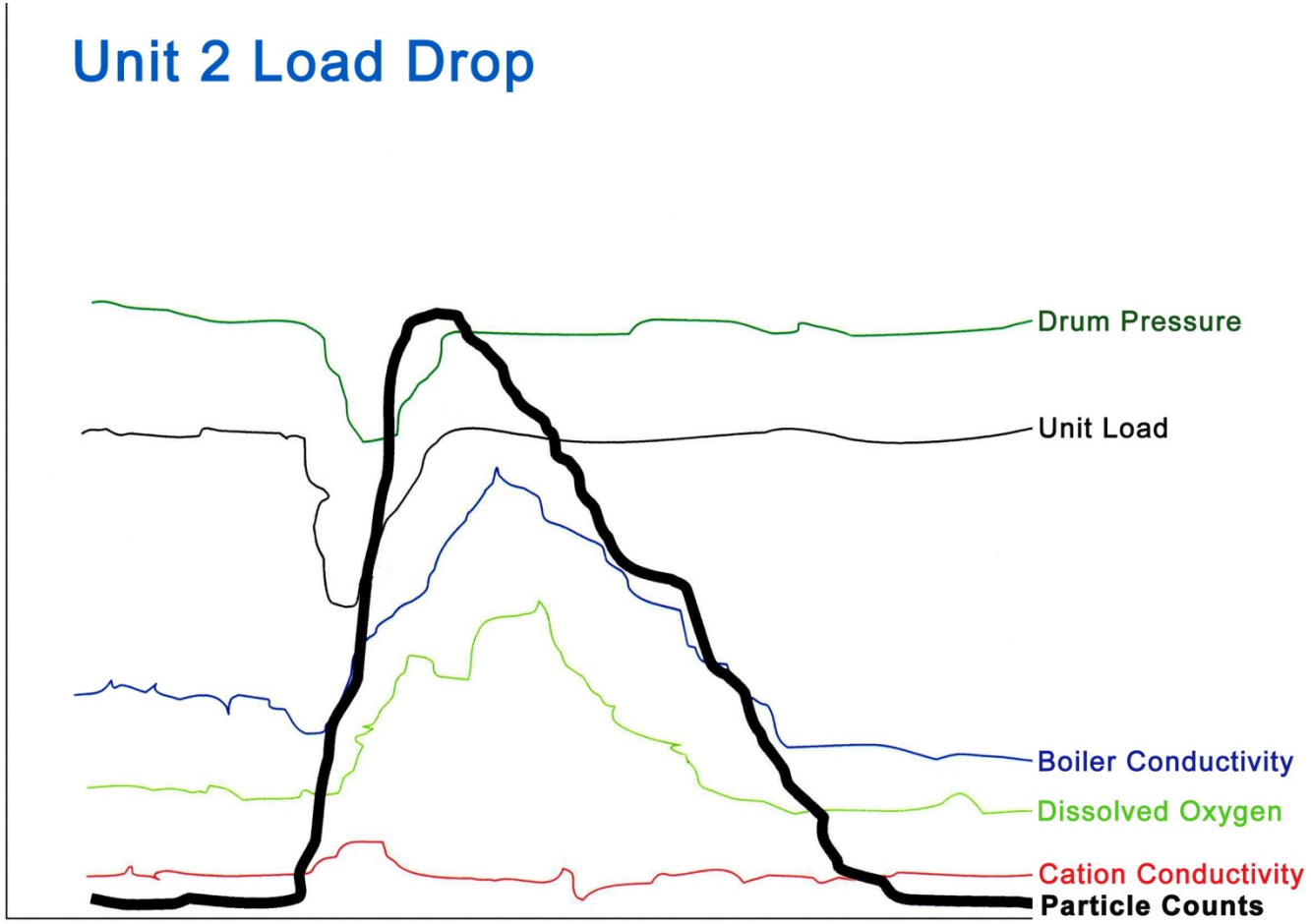
CPT Particle Monitoring

Steam Generation Cycle



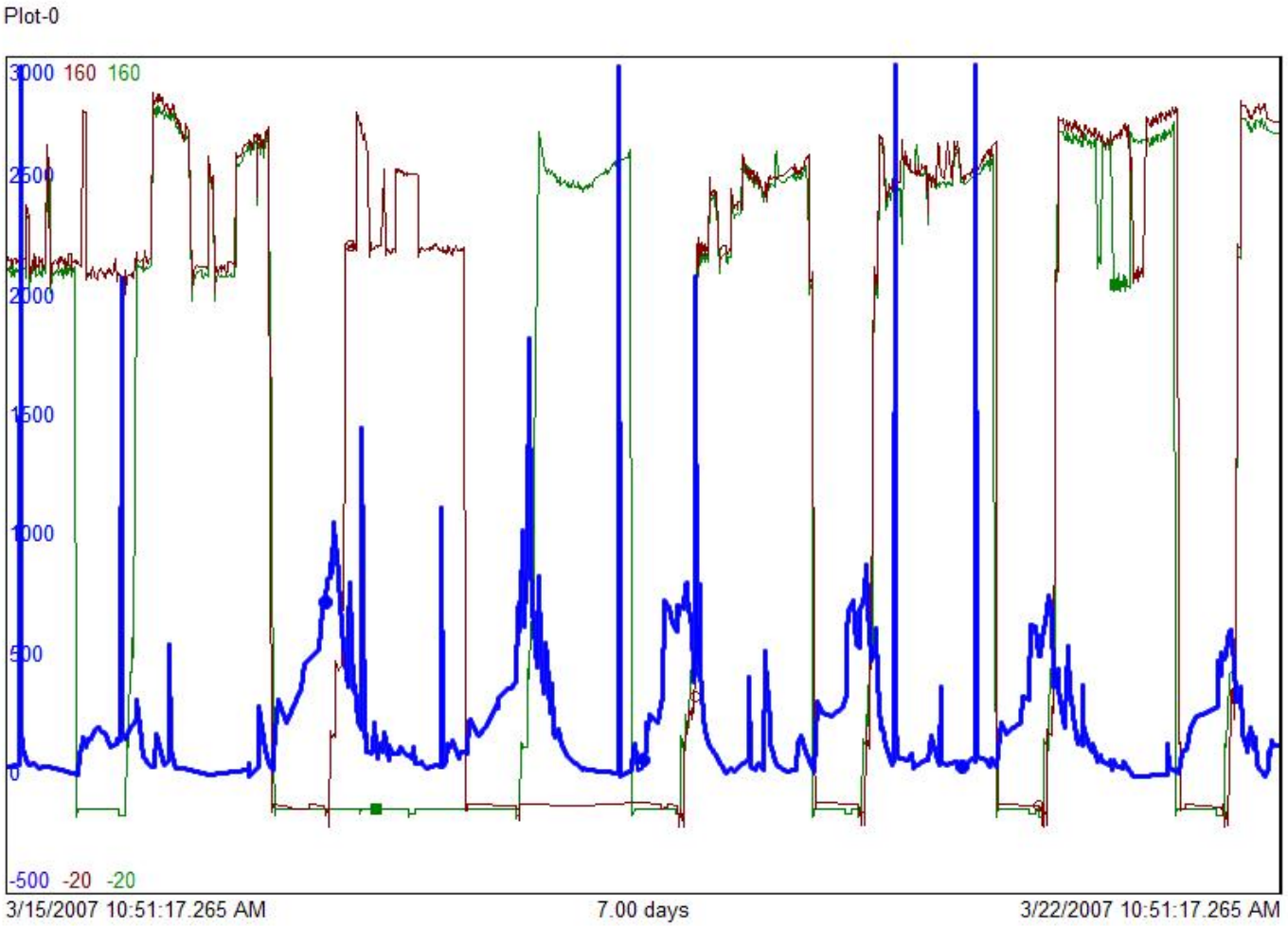
CPT Particle Monitoring

Particle Counts During Load Change



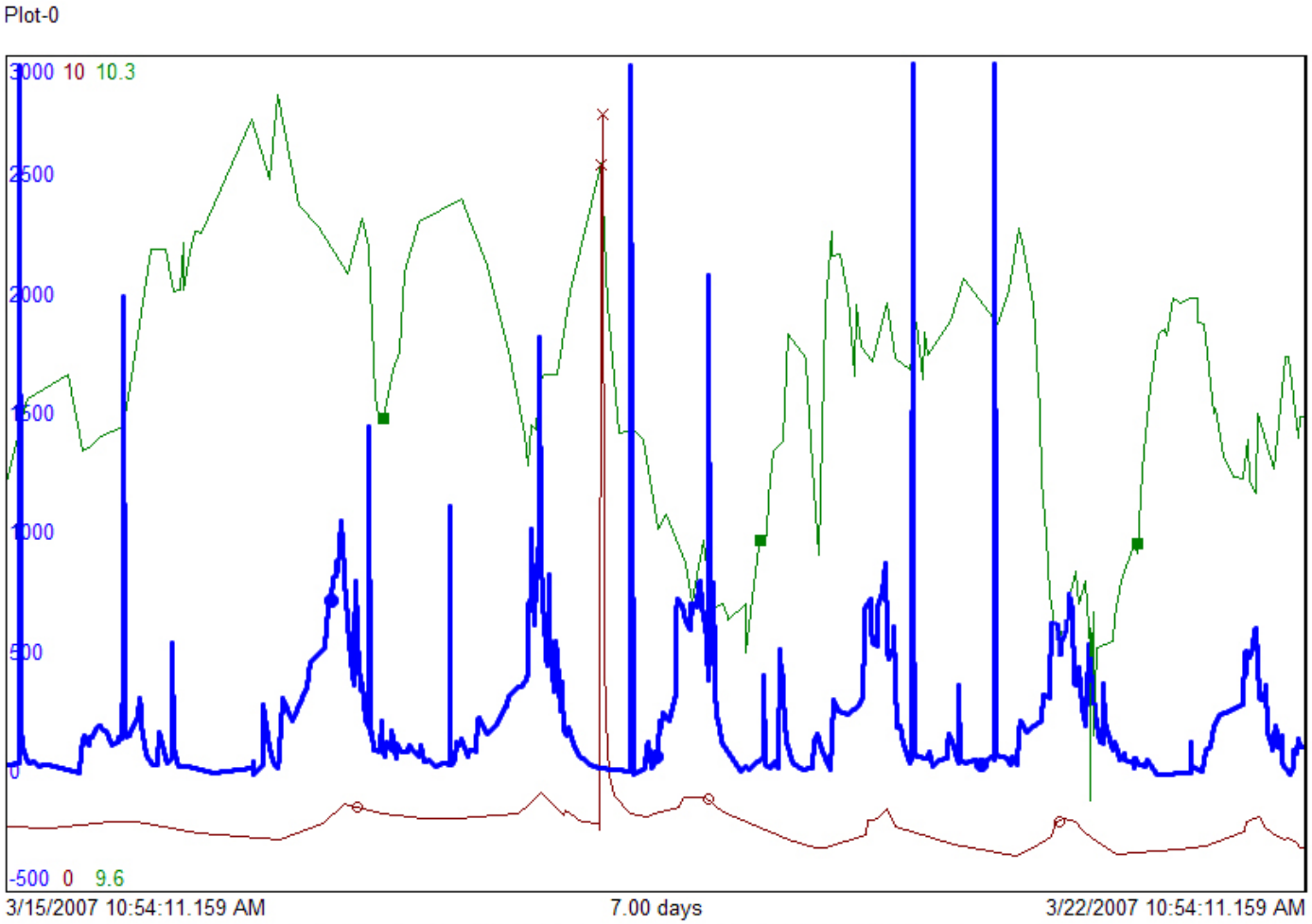
CPT Particle Monitoring

HRSG 1 MW, HRSG 2 MW, Particle Index



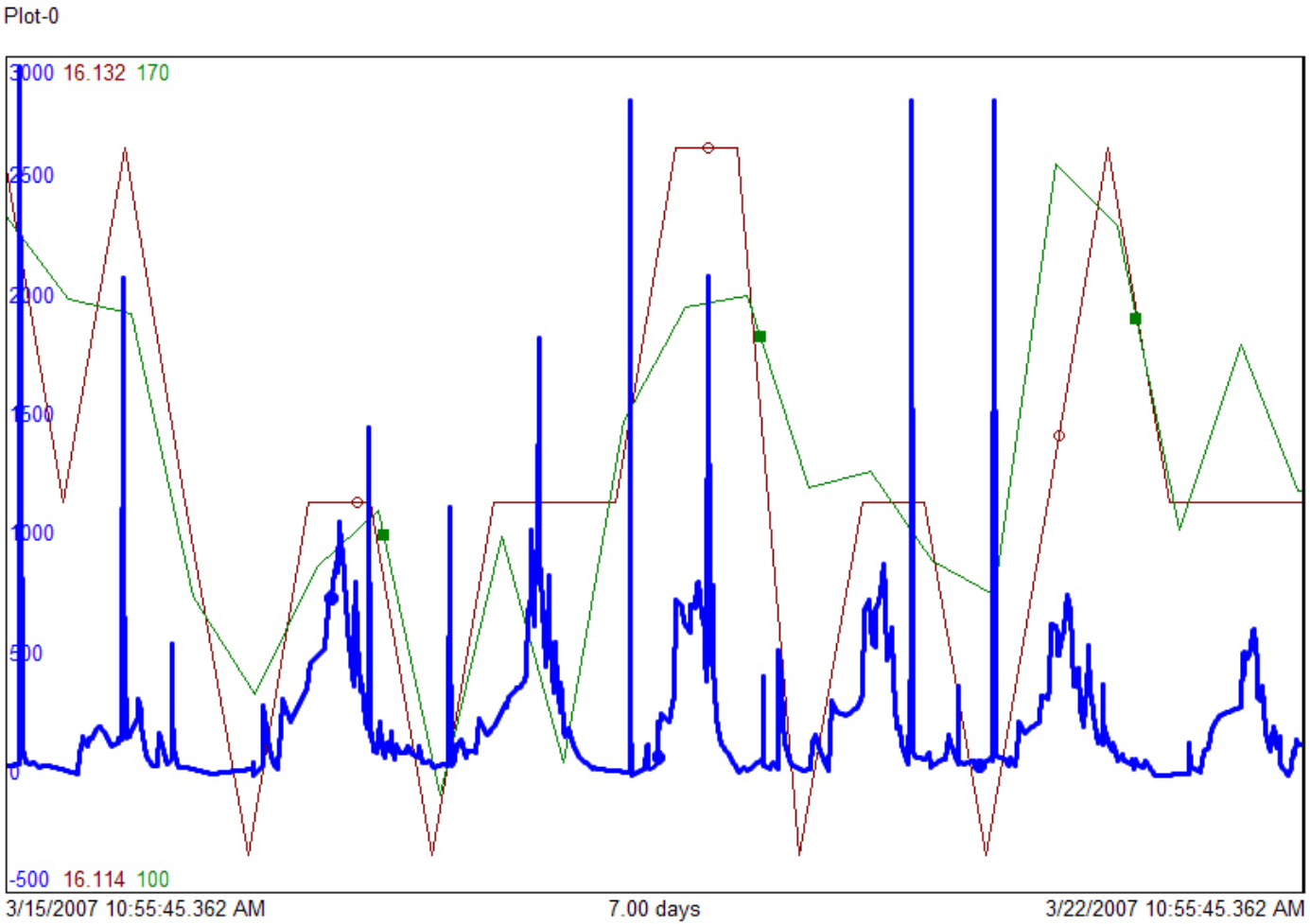
CPT Particle Monitoring

Condensate pH, Cation Conductivity, & Particles



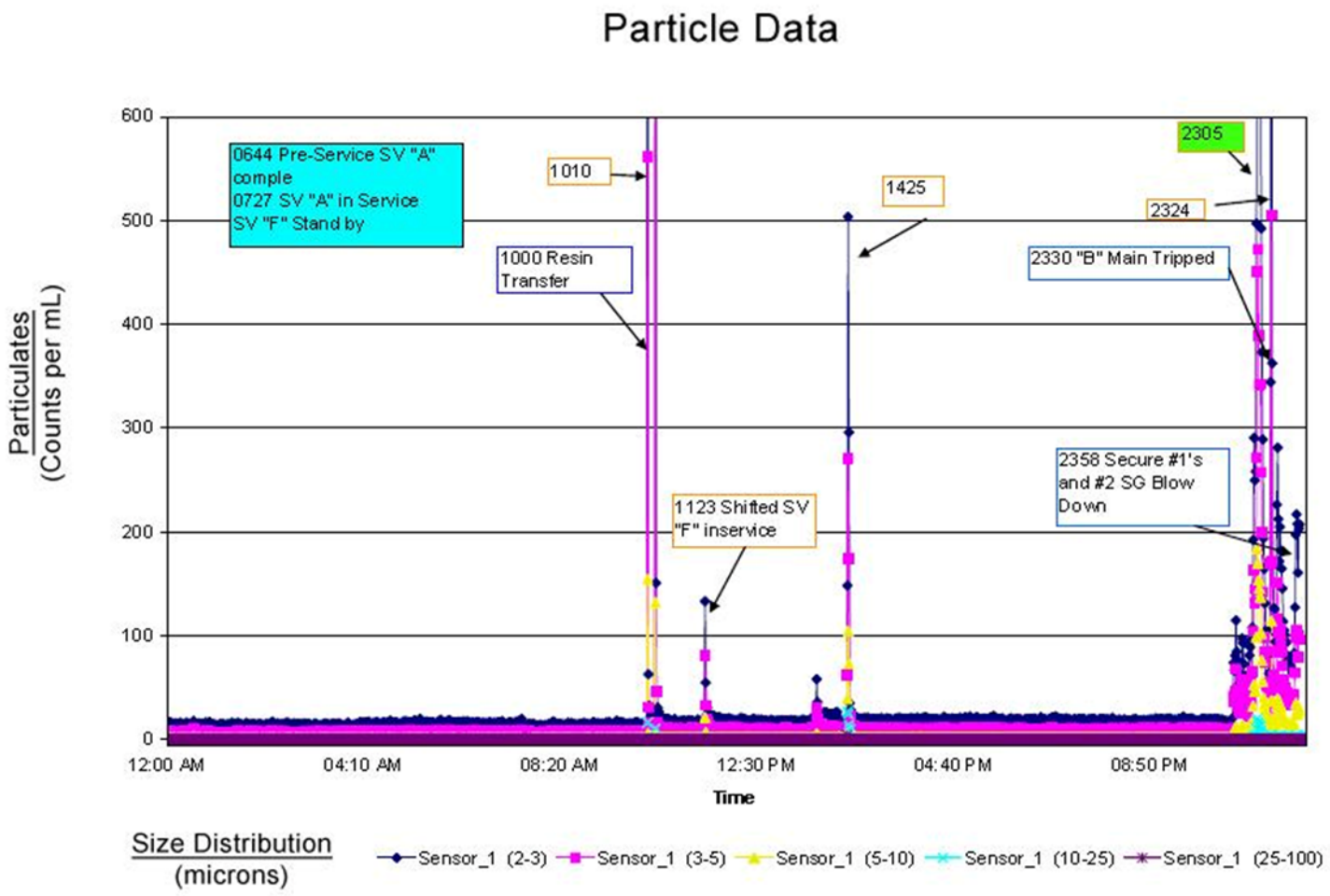
CPT Particle Monitoring

Condensate DO, ORP, & Particles



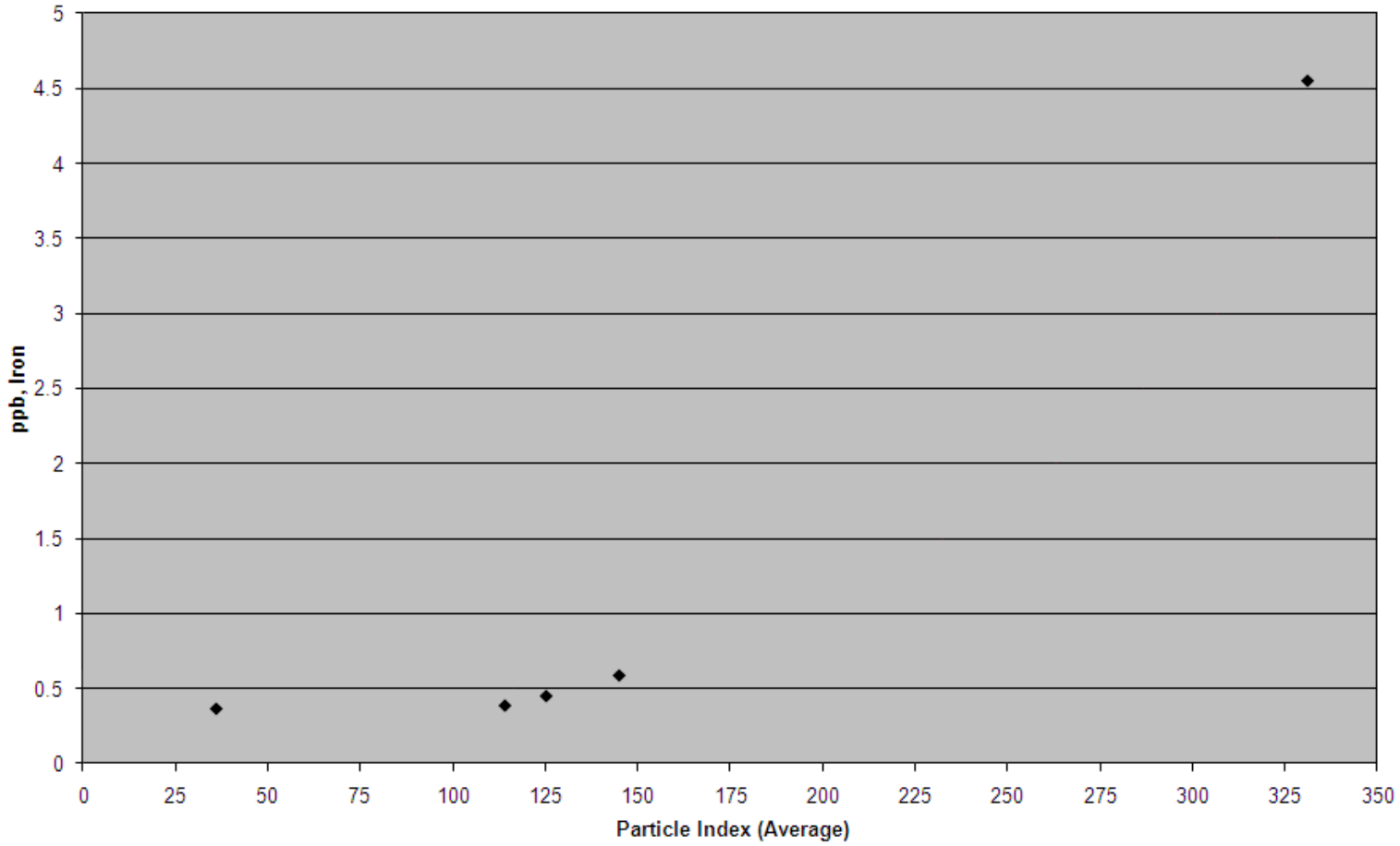
CPT Particle Monitoring

Nuclear Plant – Iron Transport Data



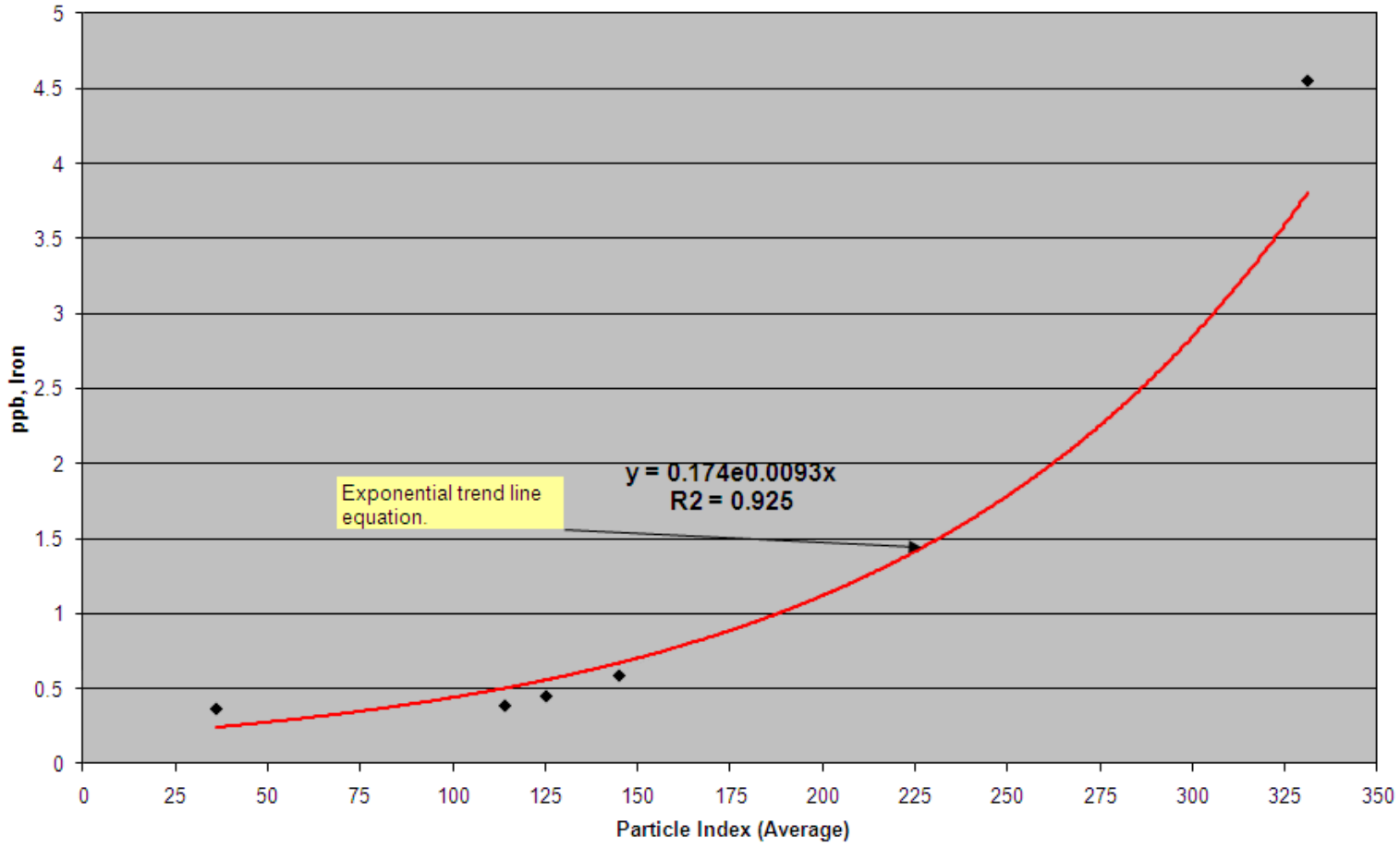
CPT Particle Monitoring

Fossil Plant – CPM Iron vs. Particle Index Average



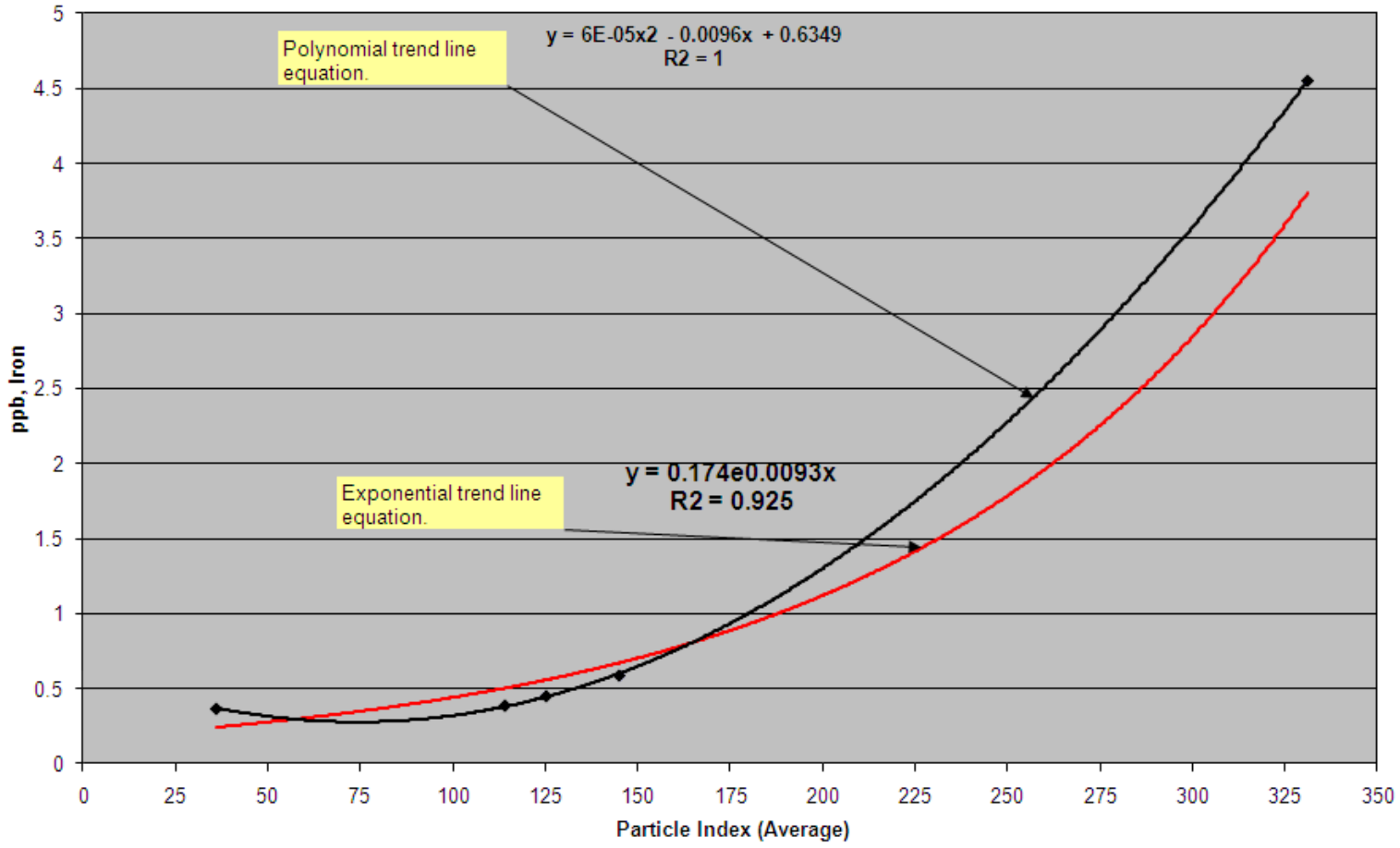
CPT Particle Monitoring

Fossil Plant – CPM Iron vs. Particle Index Average



CPT Particle Monitoring

Fossil Plant – CPM Iron vs. Particle Index Average



Conclusions

Conclusions

On-line Particle Monitoring:

- Provides ***continuous*** tracking of insoluble metal oxides…a clear advantage over “grab” or “composite” sampling
- Complements existing online ionic analyzers, offering additional analytical trends for system performance evaluation
- Offers ***real-time*** CPT results…treatment program adjustments can be made, and subsequent effects on CPT levels can be measured
- Allows for real-time recognition of CPT “events” such that immediate actions can be considered when an event occurs