Continuous Real-Time Corrosion Product Transport Monitoring using Particle Counter Instrumentation

CHEMTRAC

Introduction

Why monitor Corrosion Product Transport (CPT)?

- Corrosion and deposition are leading causes for unplanned fossil power plant outages
  - Determine when, where, and to what extent corrosion may be occurring
  - Monitor the extent that operating conditions have on metal oxide movement (e.g., chemistry, cycling)
  - Measure effectiveness of cycle chemistry program

Introduction

Why monitor Corrosion Product Transport (CPT)?

- Electric Power Research Institute (EPRI) recommends monitoring for Fe at:
  - Condensate Pump Discharge
  - Deaerator Inlet
  - LP and HP Heater Drains
  - and potentially Boiler Blowdown

- EPRI target values:
  - < 2 ppb Fe at Economizer Inlet for Fossil Fired Plants
  - < 5 ppb Fe for Drums in Combined Cycle Plants

Steam Cycle Monitoring

Traditional Methods

- *Grab sample tests*
  - **Fe and Cu analysis (soluble and total)**
  - **Millipore pads, and particle analysis**
- *On-line analyzers*
  - **Cation conductivity, sodium, silica, pH, DO, etc.**
  - **Turbidity**
- *Composite sampling*
  - **Ion exchange columns**
  - **Filter pads, and resin-impregnated filter pads**

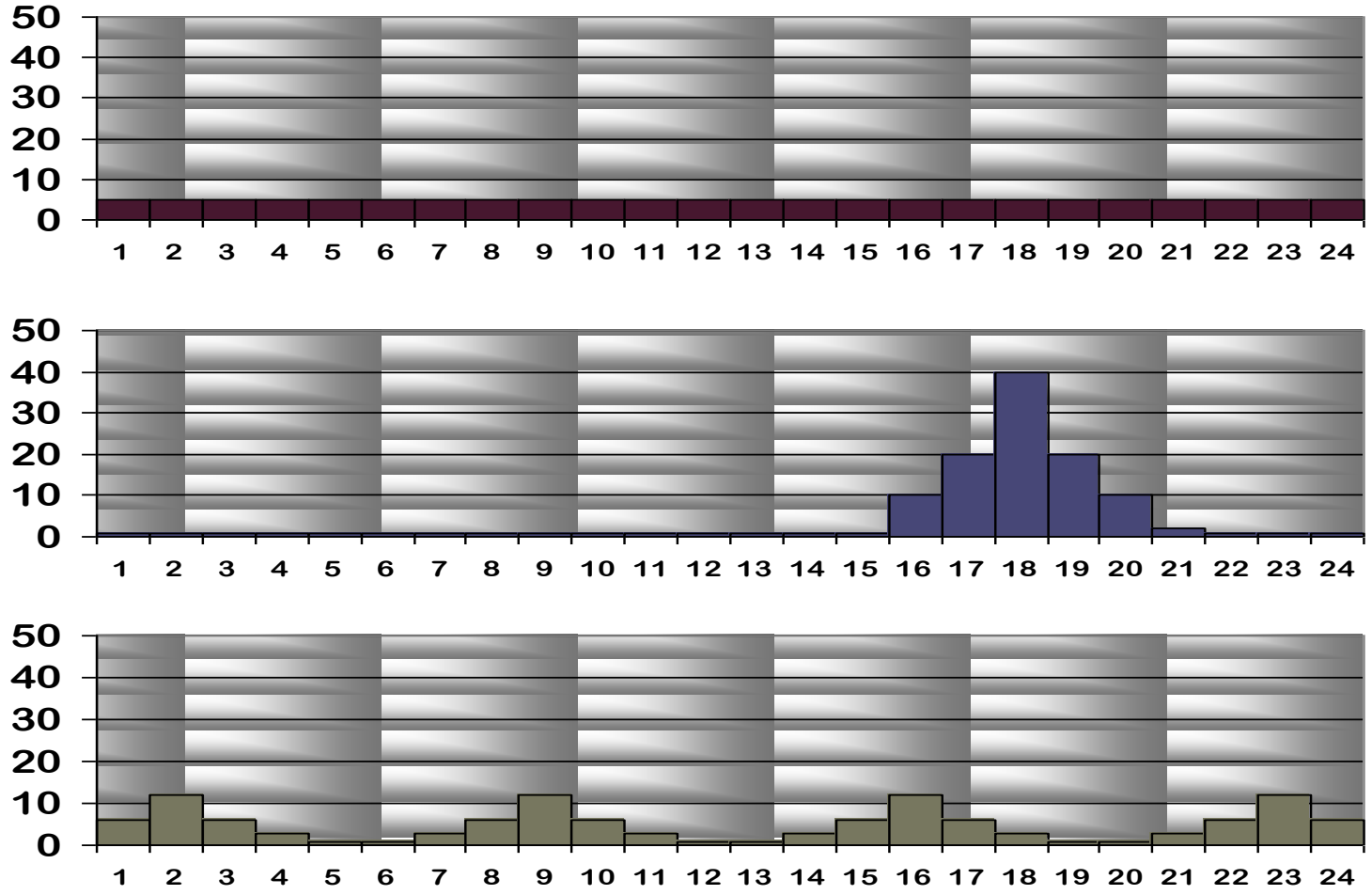
Steam Cycle Monitoring

Traditional Methods

- ***Grab Samples*** are only “snapshots”
- ***Integrated Sampling*** cannot distinguish between unique patterns and individual events
- ***Continuous Sampling*** provides minute-by-minute details that can be compared to other continuously monitored parameter trends

Steam Cycle Monitoring

Three scenarios with 5 ppb average over 24 hours



Steam Cycle Monitoring

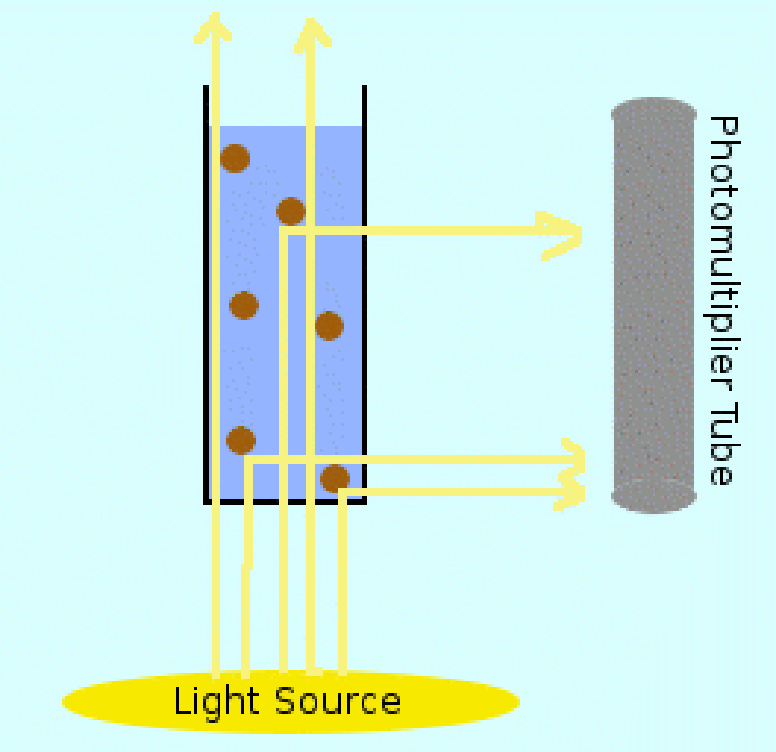
EPRI corrosion monitoring research has confirmed that ~ 90%, or more, of Fe corrosion product transport is in the insoluble (particulate) form

On-line Particle Analysis

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

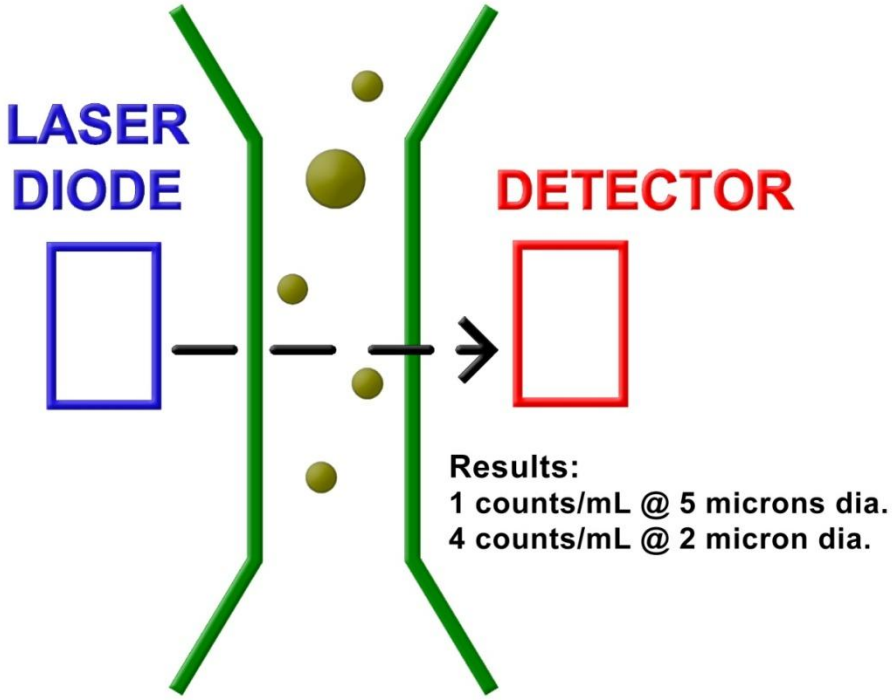
Particle Detection Technology

- Traditional Nephelometric Turbidity Monitors utilize a “light scattering” measurement



Particle Detection Technology

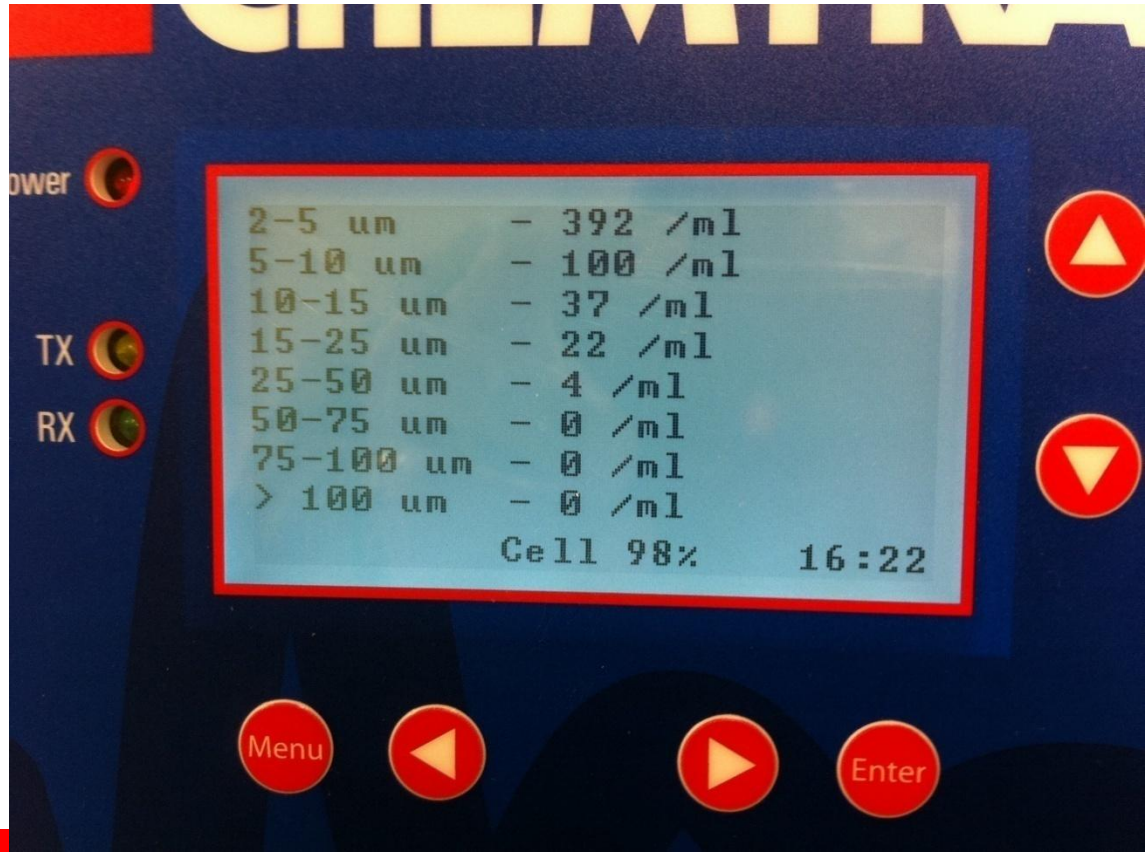
- Particle Counters & Particle Monitors utilize a “light blockage” measurement



Particle Detection Technology

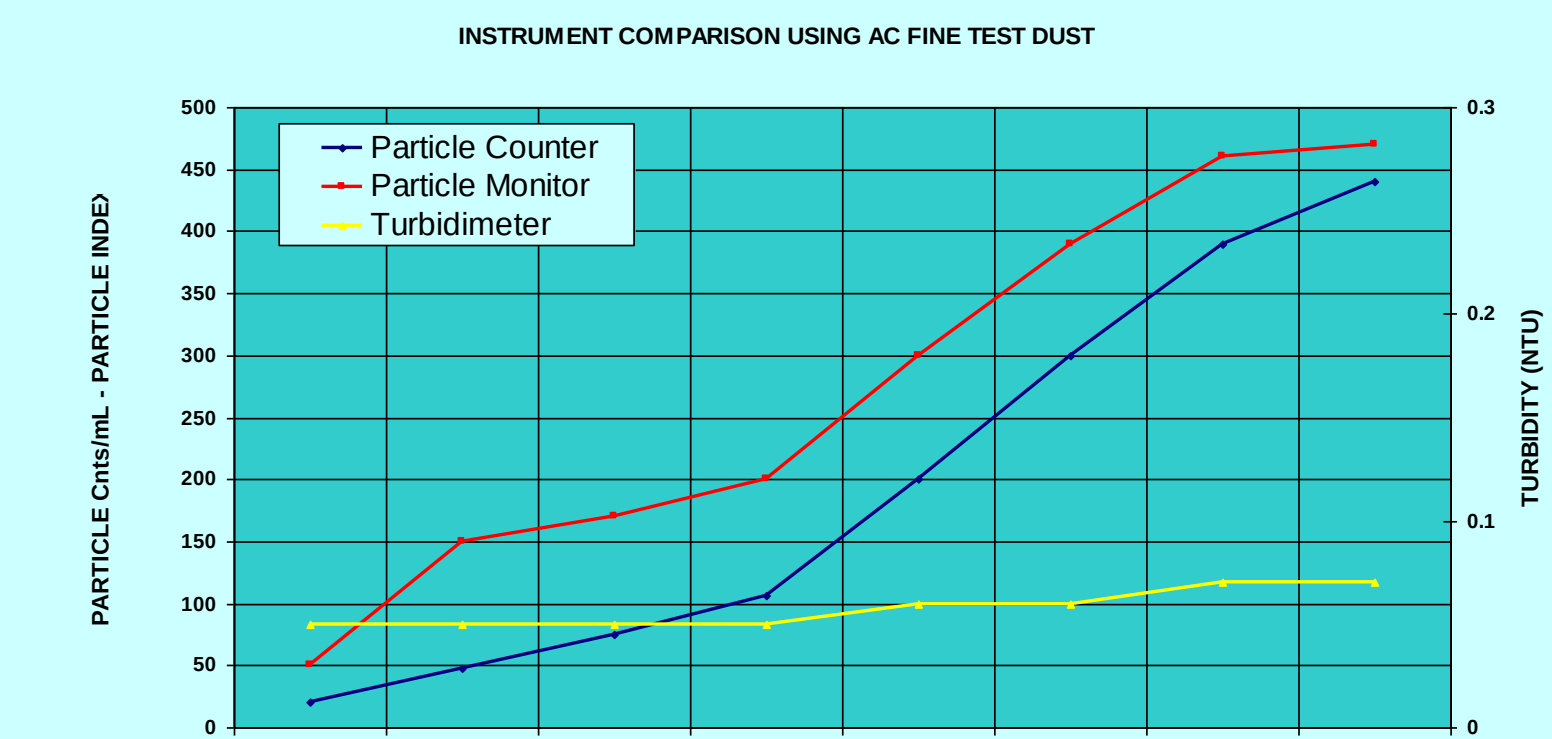
Particle Counter

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



Particle Detection Technology

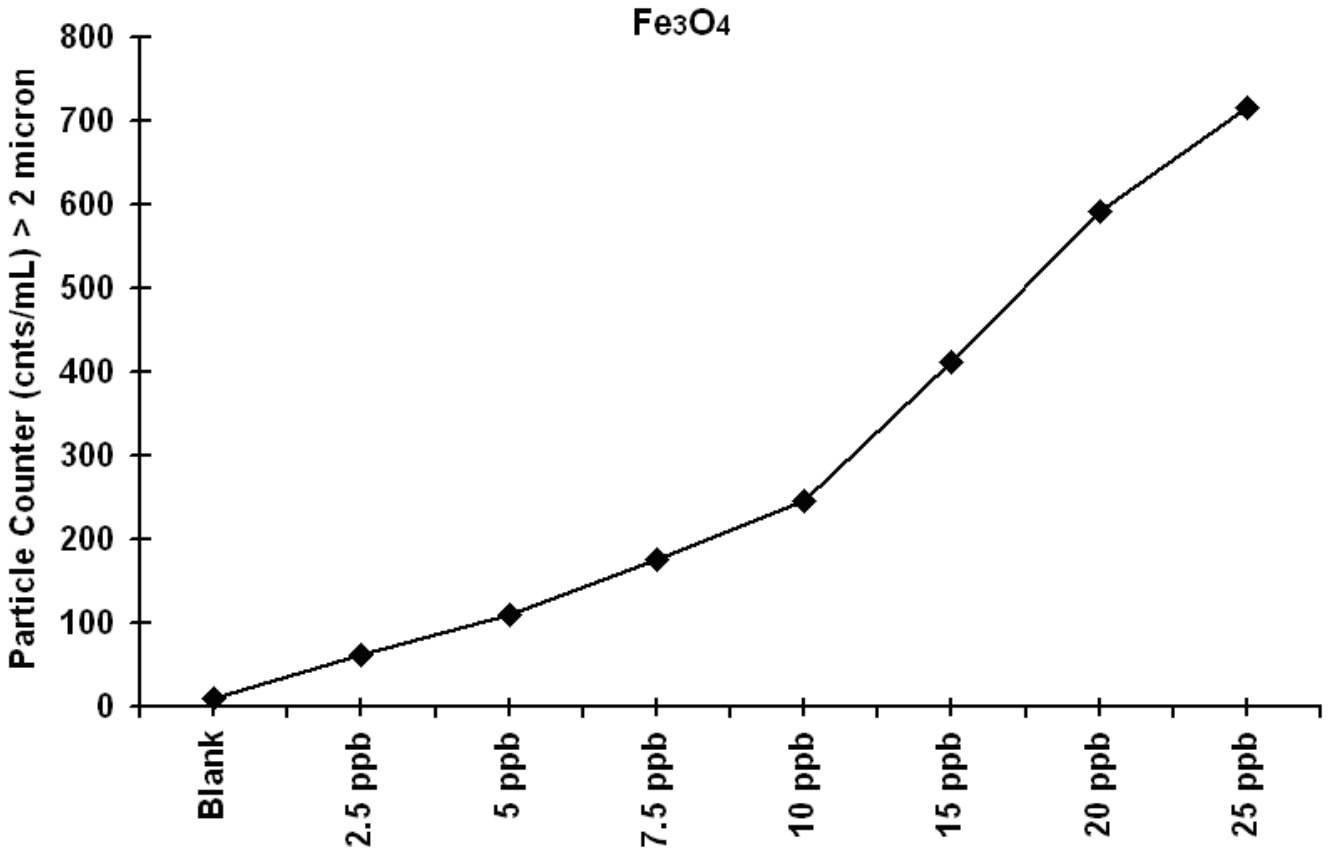
Particle Counter, Particle Monitor, Turbidity Monitor



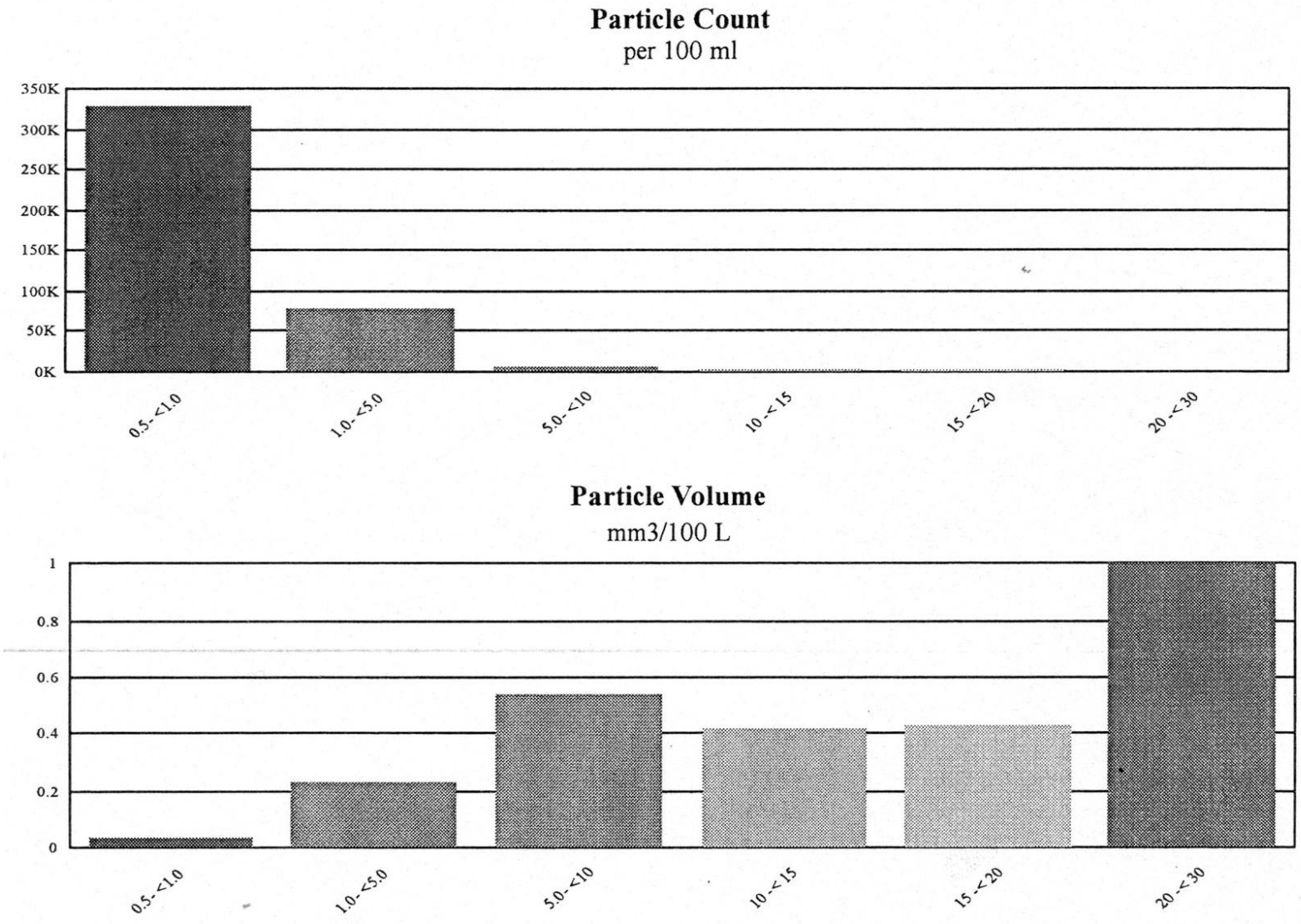
Particle Counter	21	48	75	106	200	300	390	440
Particle Monitor	50	150	170	200	300	390	460	470
Turbidimeter	0.05	0.05	0.05	0.05	0.06	0.06	0.07	0.07

Particle Detection Technology

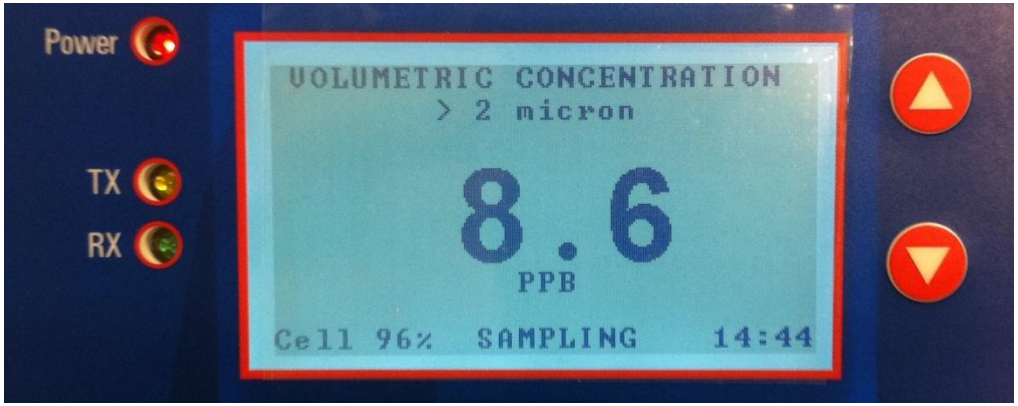
Magnetite



Particle Detection Technology



New Developments

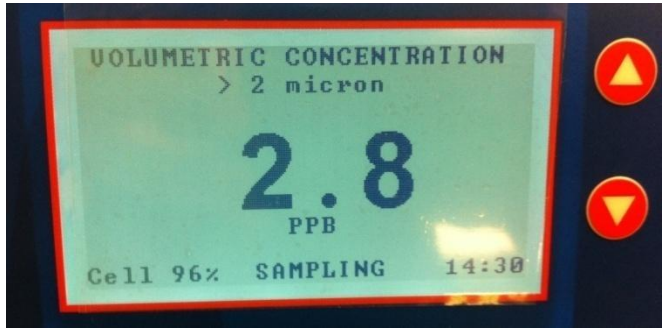


- Insoluble Materials Volume Concentration > 2 µm

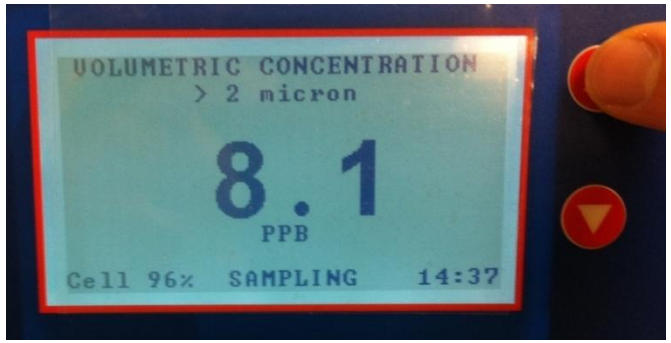
$$IMVC_{>2}$$

New Developments

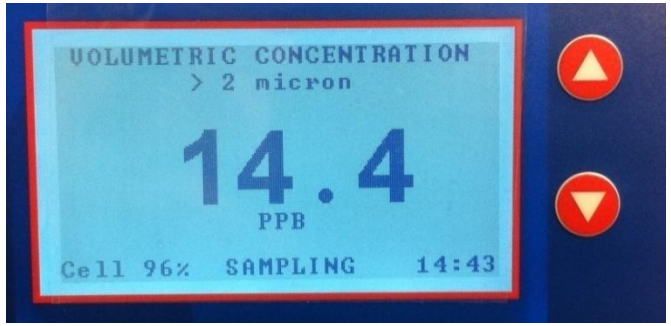
Filtered Water



+ 5 ppb Fe_3O_4

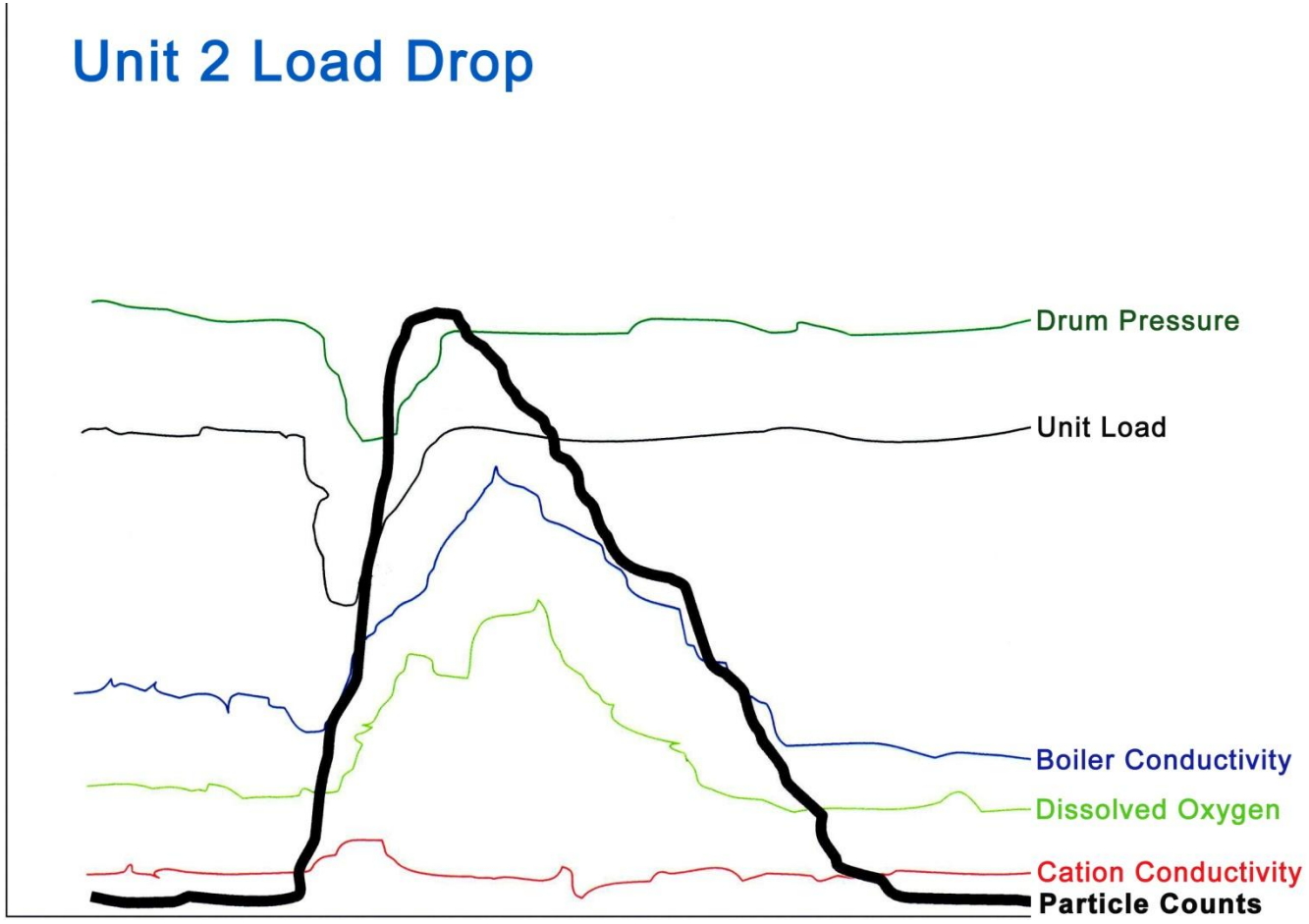


+ 10 ppb Fe_3O_4



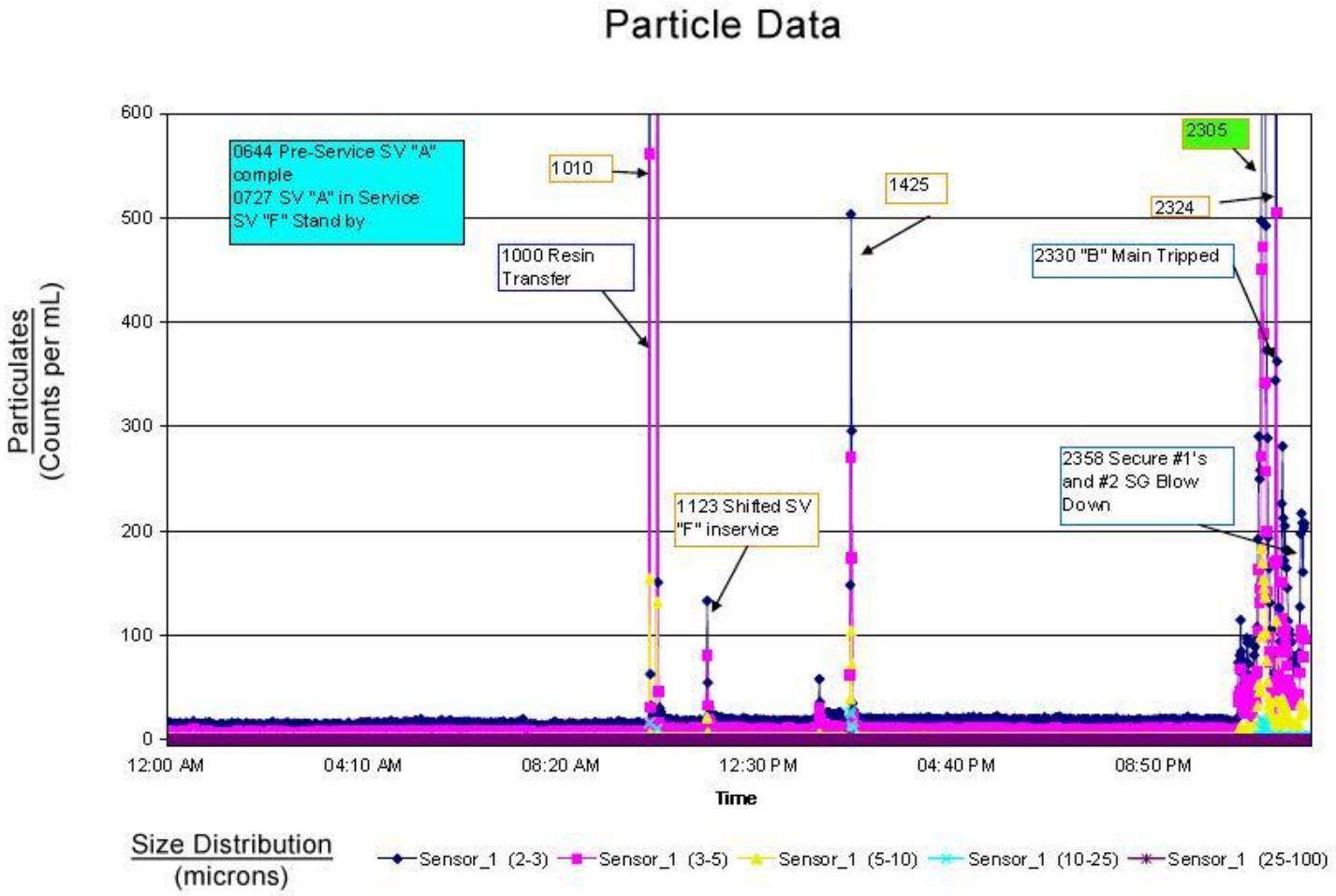
CPT Particle Monitoring

SW US Fossil Plant – Combined Trends



CPT Particle Monitoring

SW US Nuclear Plant – Identifying Events



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

"There's a way to do it better...find it."

- *Thomas Edison*