REINHOLD ENVIRONMENTAL Ltd.

2012 APC Round Table
& Expo Presentation

July 16-17, 2012, in Baltimore, MD / Hosted by Duke Energy, Entergy, FirstEnergy, Southern Company & TVA

PLANNING & CONDUCTING EFFECTIVE SORBENT INJECTION TRIALS

2012 APC Round Table

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PRESENTATION OVERVIEW

- Presentation
  - Audience is Panel
  - Discussion Encouraged
  - Scope for New & Experienced
- Q & A/ Discussion

Background & Perspective

- 24+ Years of Utility Power Plant Experience
- 12+ Years of SO_3 Mitigation Experience
- Testing, System Design & Construction, O&M

- Tested Most Available Reagents
  - Calcium (Hydrated Lime, Limestone, Cao)
  - Sodium (Trona, Sodium Bicarbonate, SBS) (Wet & Dry)
  - Magnesium (Mag Hydroxide (Wet & Dry), Magnesium Sulfate (Wet)

- Various Injection Locations
  - Wet & Dry
  - Furnace to FGD Inlet
  - Coal Additives

- Integrated/ Holistic Approach Critical
- DSI Experience is growing rapidly
- Past experience critical but past conclusions can be misleading

IMPORTANCE OF DSI TRIAL PLANNING

Initial Trial Planning Critical

- Often significant decisions & costs are at stake
- Inaccurate / Incomplete Data or Wrong Conclusions can be very, very costly!!
  - Minimum may require re-testing
  - Worse could lead to wrong decisions regarding compliance strategies
- Want to Maximize Useful Data @ Least Cost

PRE PLANNING DECISIONS

Already Considered

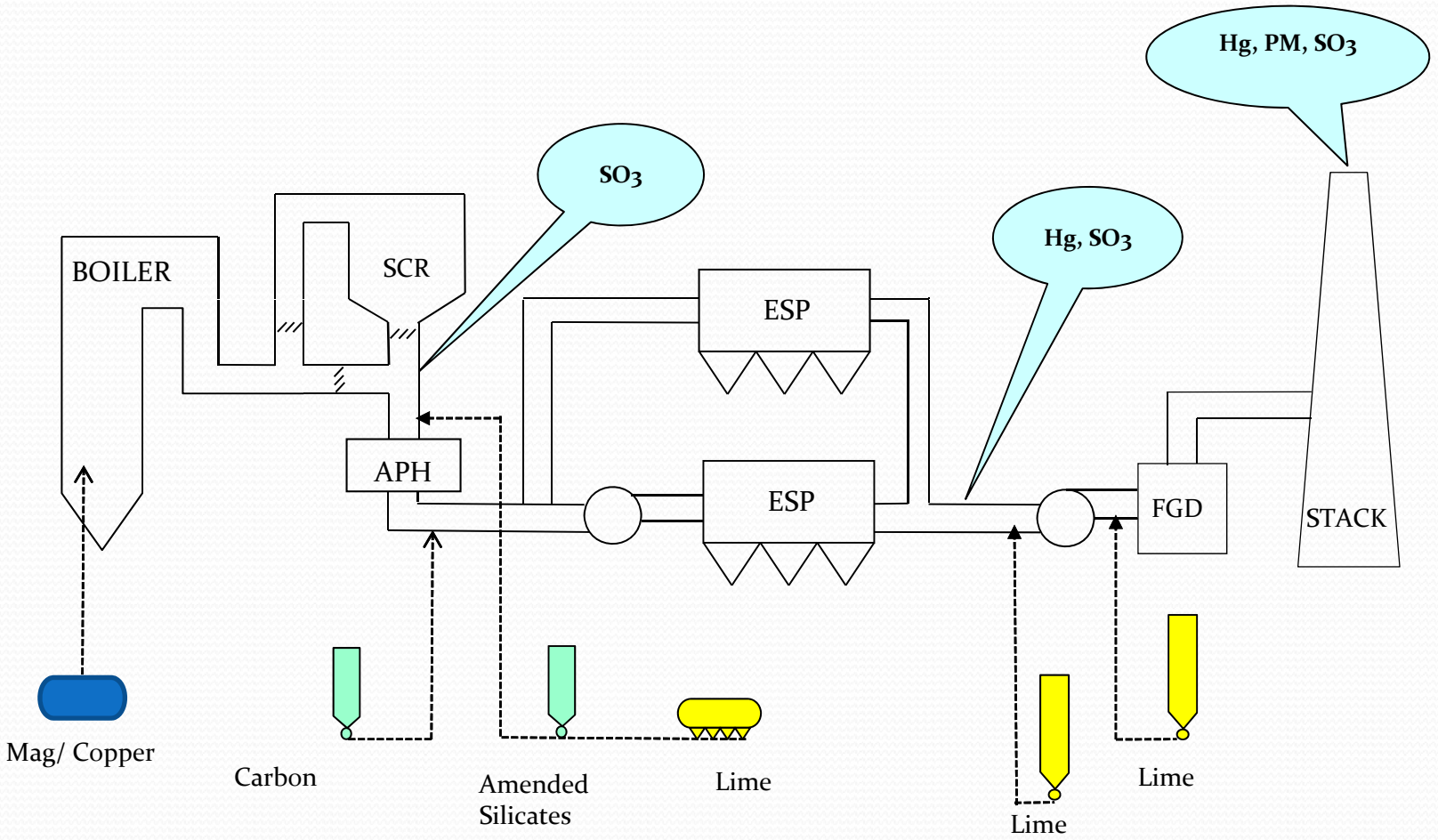
- Target Pollutant(s)
- Compliance Targets
- Compliance Timeframe
- Potential Compliance Strategies
- Expected Unit Dispatch
- Expected Unit Life
- Other considerations

>>Determined DSI Trial is Needed

DSI TRIAL PLANNING – GENERAL CONSIDERATIONS

- Iterative process
- Cost
- Practicality
- Data Prioritization
- Whole Unit vs Part unit DSI
- Unit Conditions
- Input from station - Critical
  - More complex >>more input & planning, meetings required

COMPLEX TEST LAYOUT



DSI TRIAL PLANNING

Determine Trial Objectives

- Primary Goals?
  - Quantify/ Confirm Performance
  - Determine Sorbent Choice
  - Determine BOP Impacts
- Secondary Goals? - THINK AHEAD, THINK INTEGRATED
  - Corrosion Mitigation
  - Reduce APH Pluggage
  - Secondary acid gas mitigation
  - SCR Turndown
  - Other Beneficial BOP Impacts?

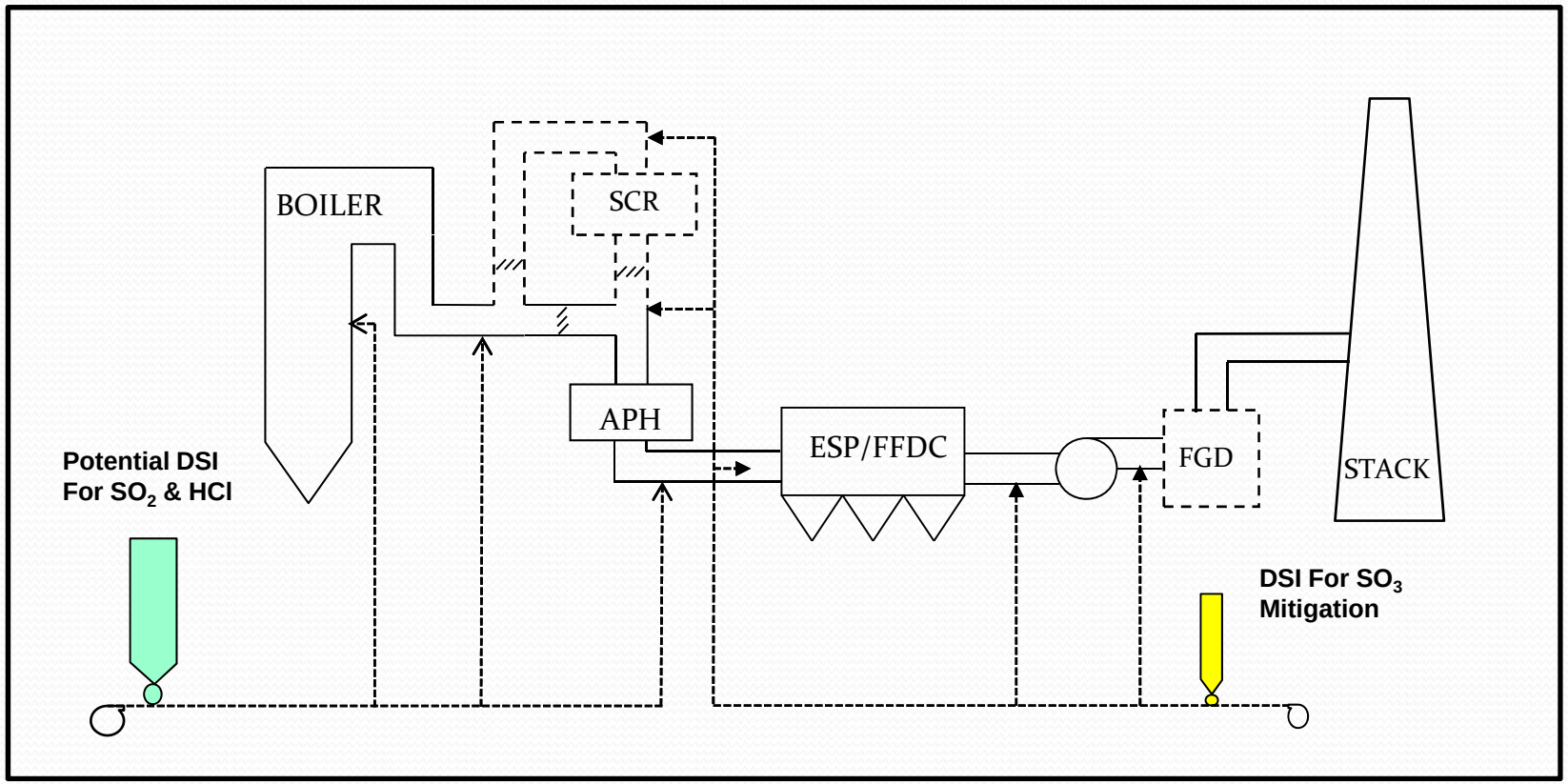
Screening trial –vs-Longer term trial

DSI TRIAL PLANNING

Limitations & Constraints

- Time Constraints
- Cost
- Unit Configuration
  - Current Equip
  - Inject Loc Possibilities
    - Residence Time, Etc
- Fuel
  - Type
  - Delivery Issues

POTENTIAL DSI INJECTION LOCATIONS



DSI TRIAL PLANNING - CONSIDERATIONS

Test System Design

- Reagent Type(s)
- Expected Feed & Turndown
- Expected/ Potential Trial Duration
- Utility Design & Constructed
- Vendor Rental System

Plant Site Planning & Preparation

Sampling Location - Critical

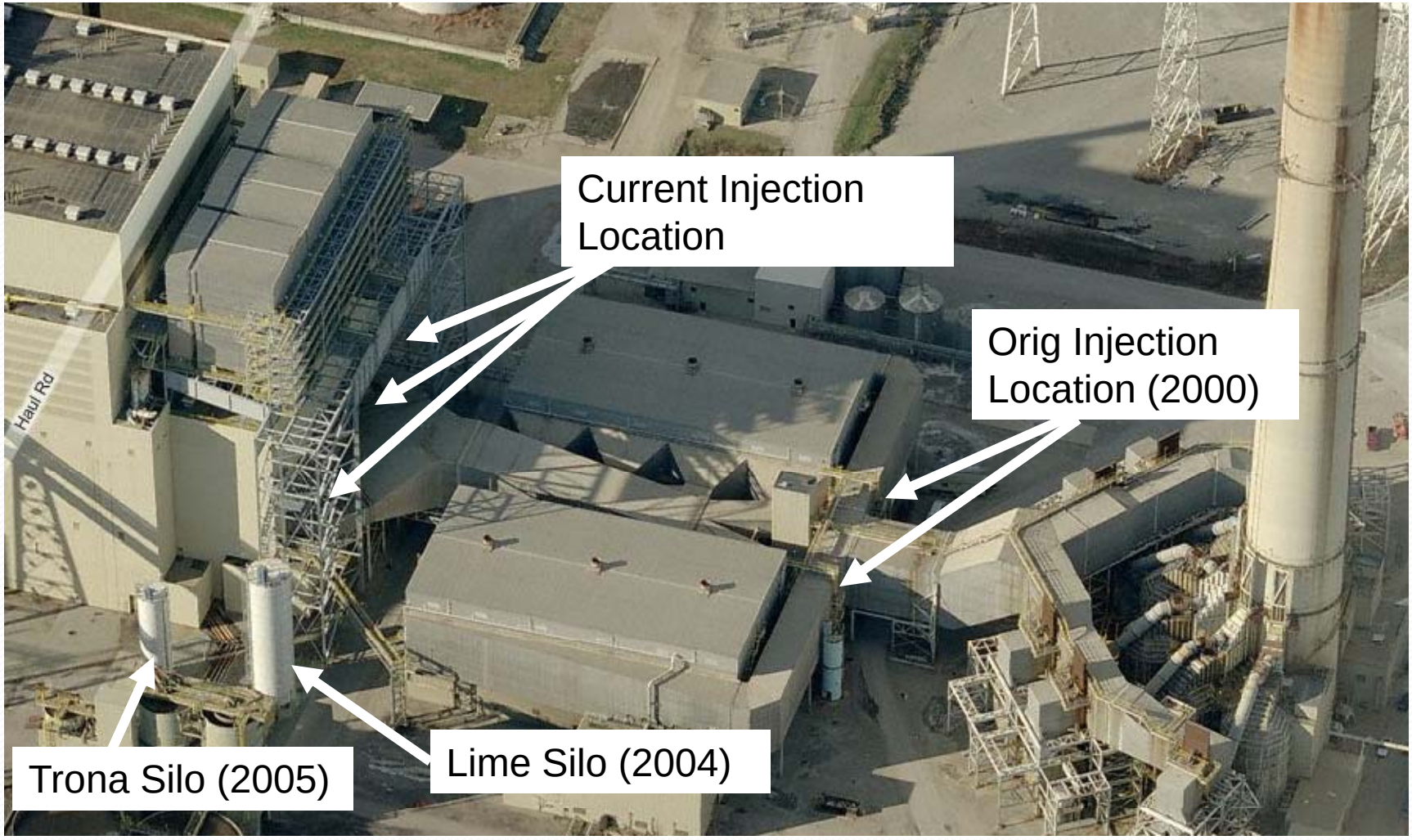
- Stratification
- Gas/ Aerosol State
- Air Inleakage
- Sorbent & Dust Loading

Injection Location – Critical

- Temp
- Gas Flow Pattern

Ports & Internal Obstructions – Verify

Example of Station with Multiple Injection Systems



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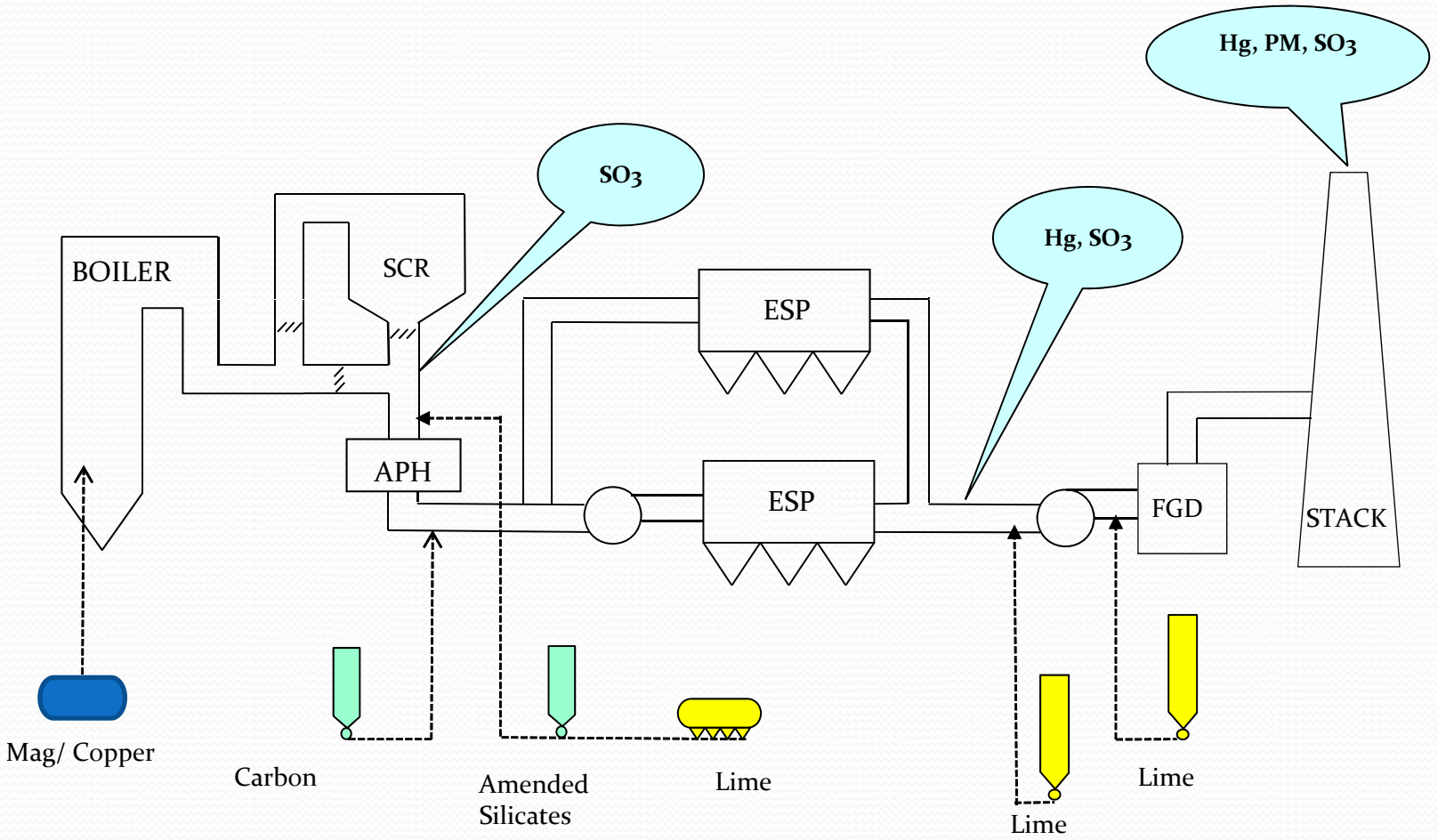

DSI TRIAL PLANNING - CONSIDERATIONS

Sampling & Data Collection

- Selection of Gas Sampling Firm
- Continuous (CEMS) vs. Periodic Sampling
- 'Steady State' determination
- Data Repeatability
- Ash & Gypsum Sampling

DSI TRIAL CONTINGENCY PLANNING

Potential Trial Problems

- DSI Equip Issues
  - Feed Problems
  - Dispersion
  - Reagent Delivery
- Sampling Issues
  - Sampling Equip Problems
  - Unreliable Data
- Plant Issues
  - Unit Load Variability
  - Other Plant Systems
  - Coal Consistency

Know Most important objectives & adjust accordingly

DSI TRIAL PLANNING & EXECUTION

Unit Conditions

- Full Load vs. Cycling
- Coal Loading Schedule
- Furnace Conditions
  - NOx Set Point
  - Sootblowing Schedule

AQCS Conditions

- SCR Operation
- ESP & FFDC Condition
  - Rapping Schedule
  - Ash Sampling
  - Bag Cleaning schedule
  - Ash Sampling
    - Hopper Evacuation
- FGD Conditions

DSI TRIAL EXECUTION & DATA COLLECTION

Prelim-Testing

- DSI System
- Check CEMS
- Determine/ confirm minimum ***acceptable*** conditioning time

Coordinate and Follow Test Plan

Initial Results Review

- Daily Review of results
- Compare to expected

DSI TRIAL – EVALUATION OF BOP IMPACTS

Impacts determined in part by:

- Reagent
- Feed rate
- Injection Location
- Residence Time
- Dispersion Pattern
- Fuel
- Existing Equipment & Systems Issues
- Ash Disposal
- Unit Cycling

DSI TRIAL – EVALUATION OF BOP IMPACTS

SORBENT IMPACTS BASED ON INJECTION LOCATION

- Pre-FGD
  - PM
  - ME Pluggage
  - Duct Layout
- Pre ID Fan
  - Fan Deposits
  - Erosion
- Pre ESP
  - Resistivity
  - Mass Loading
  - Ash Handling
  - Ash Disposal
- Pre APH
  - Hg Impacts
  - Pluggage Concern
- Pre SCR
  - Catalyst Impacts
  - Hg Impacts (HCl)
- Boiler
  - Pluggage
  - Deposits

HYDRATE DISPERSION

HYDRATE DEPOSITS TYIPICALLY ONLY A PROBLEM WITH MOISTURE

DSI TRIAL – EVALUATION OF BOP IMPACTS

- Many BOP Impacts take time to show
  - Allow sufficient time if necessary
- Many BOP impacts require inspections to confirm
  - Sooner is better
- Careful not to blame DSI for other root cause

DSI TRIAL – COMPLETION

- Review Data Immediately
- Determine if additional testing needde before removing Test System

SUMMARY & CONCLUSION

- Planning is Critical to Success
- Know Objectives
- Know Data Priority
- Expect Problems and Be Ready to Adjust
- Consult with Plant
- Consult with Experienced Personnel