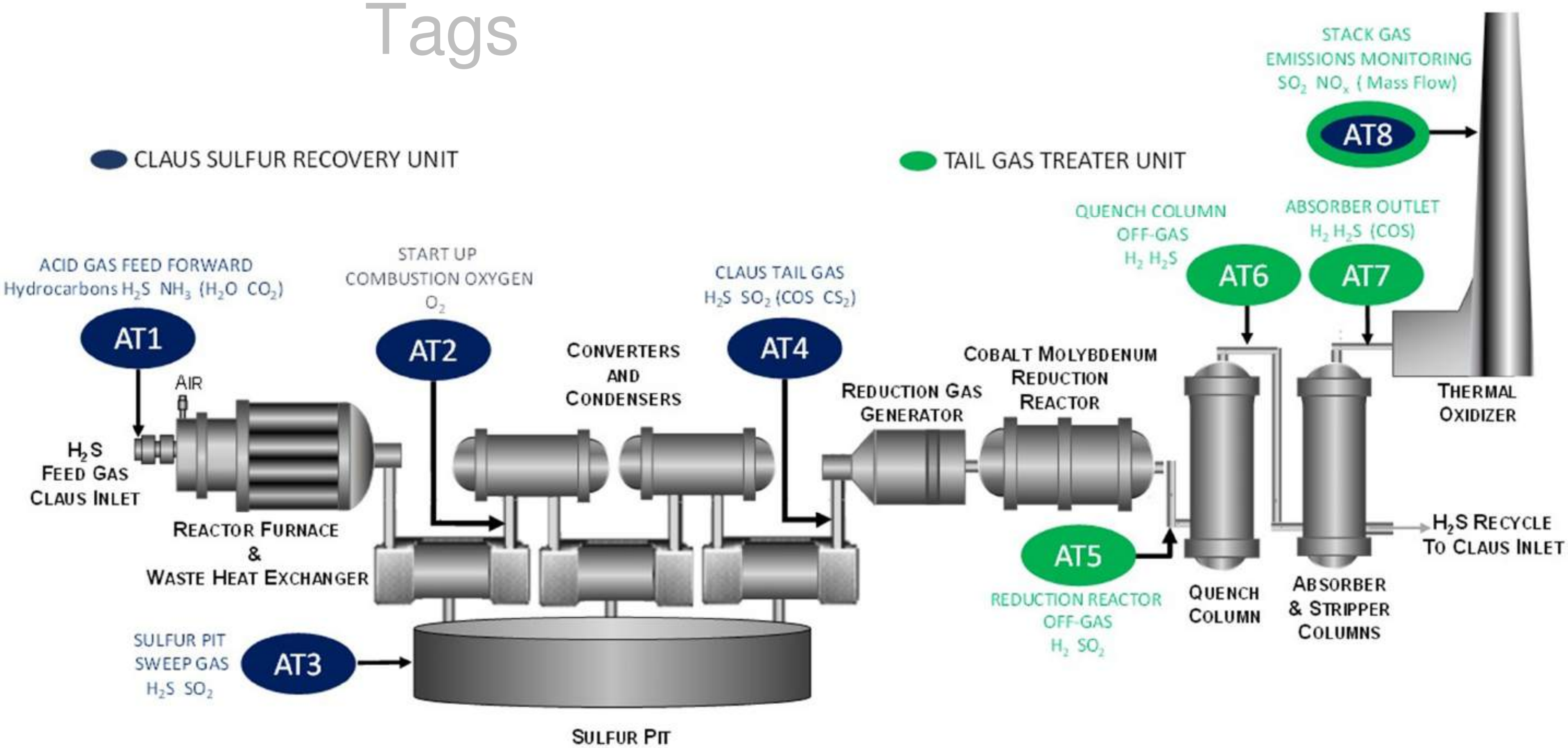
SRU-TGTU Analyzer Best Practices

RefComm Galveston 2016
Sulfur Recovery

REFCOMM®
GALVESTON
MAY 2-6 2016

SRU-TGT Analyzer Tags



AT-1 (Acid Gas)

H_2S + Total Hydrocarbon

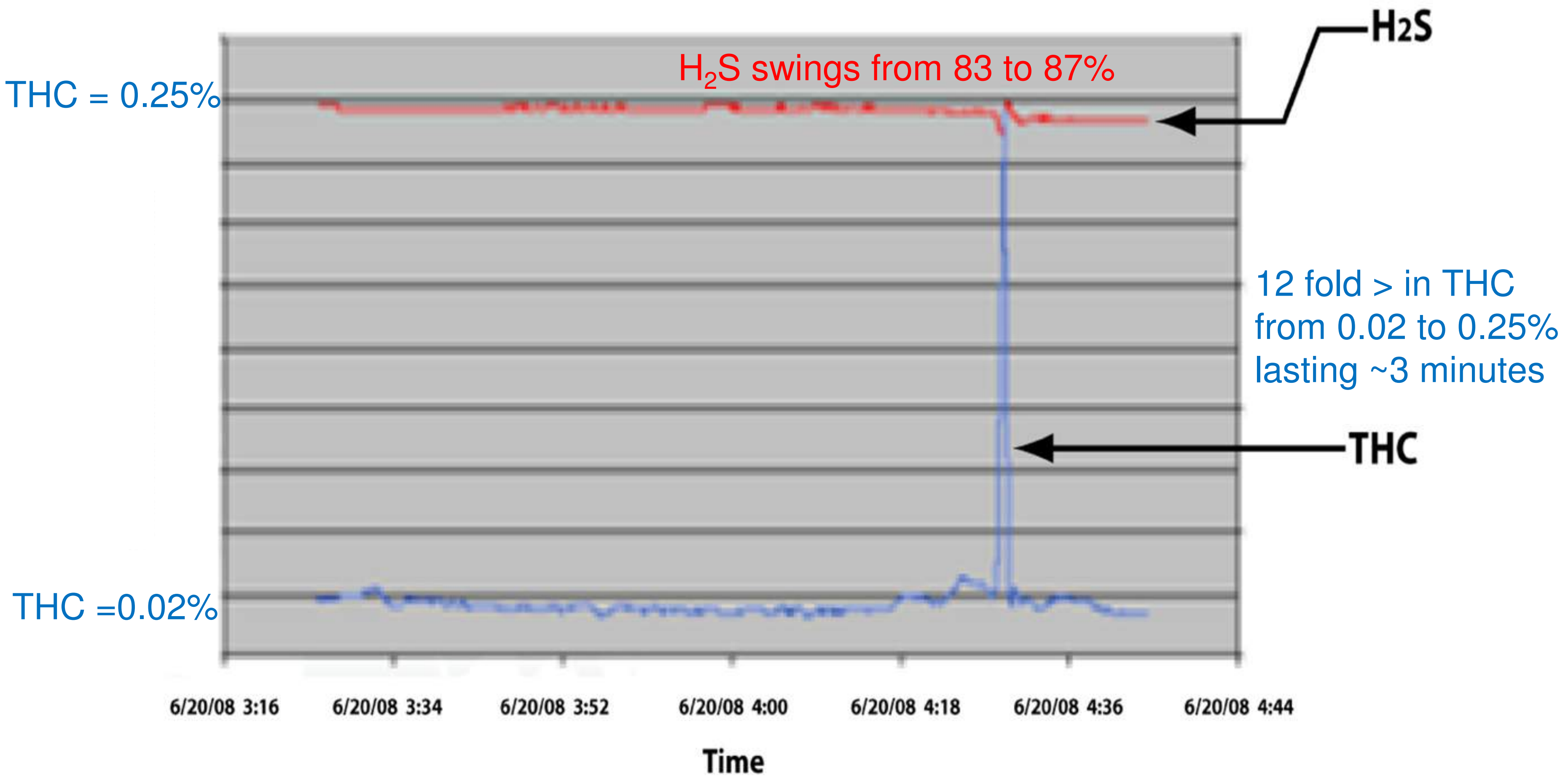
(CO_2, H_2O, NH_3)

(BTEX, MeOH)

O_2 Required to Burn Hydrocarbons Compared to an Equal Amount of H_2S

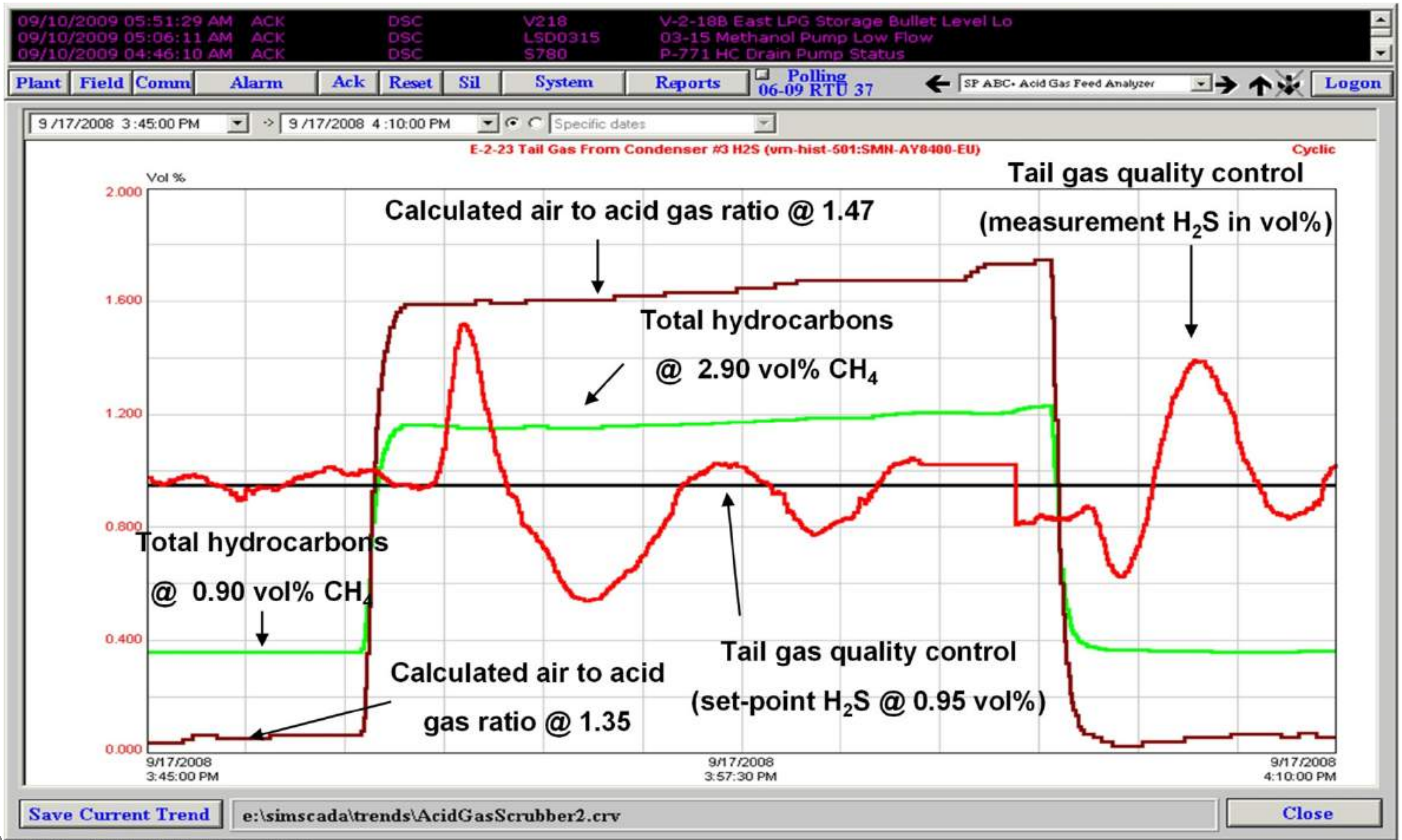
Compound	Moles O_2 per Mole HC	Ratio of O_2 needed per mole HC compared to mole of H_2S
Methane	2	4
Ethane	3.5	7
Propane	5	10
Butane	6.5	13
Pentane	8	16
Hexane	9.5	19

Field Data / HC Process Upset



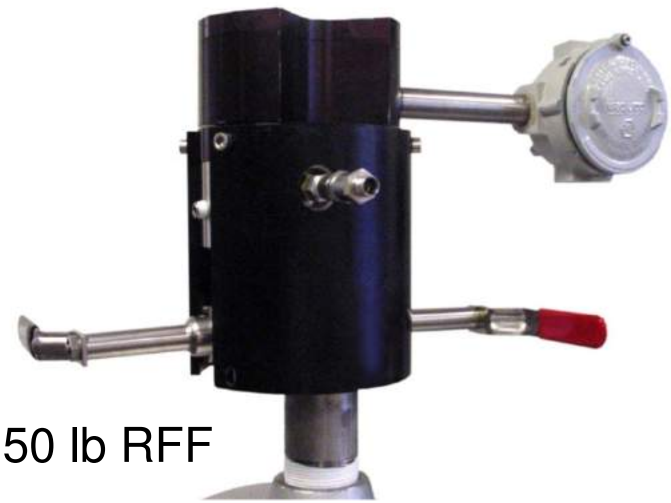
Feed Forward Analysis: Actual Control Response to Hydro-Carbons

(Courtesy of Jacobs Comprimo)



Acid Gas Analyzer / Summary

- Benefits
  - For SRUs with TGTU: Mitigation of SO_2 breakthrough to the amine absorber…Its not when the HC comes that makes the problem, its when the HC goes away
- To be "ready" install a heated acid gas probe at shutdown



2" 150 lb RFF

AT-4 (SRU Tail Gas)

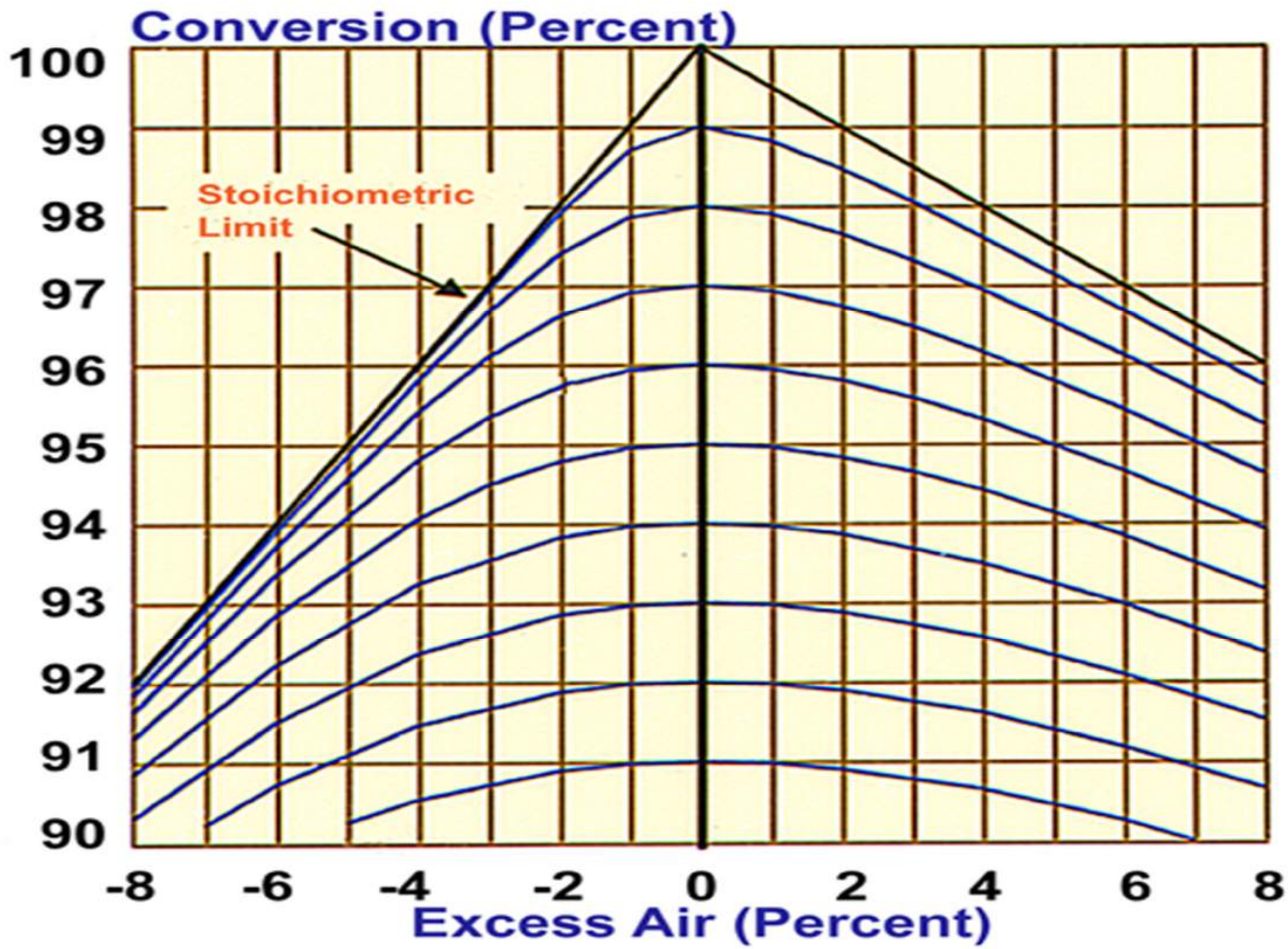
H_2S / SO_2

(COS, CS_2)

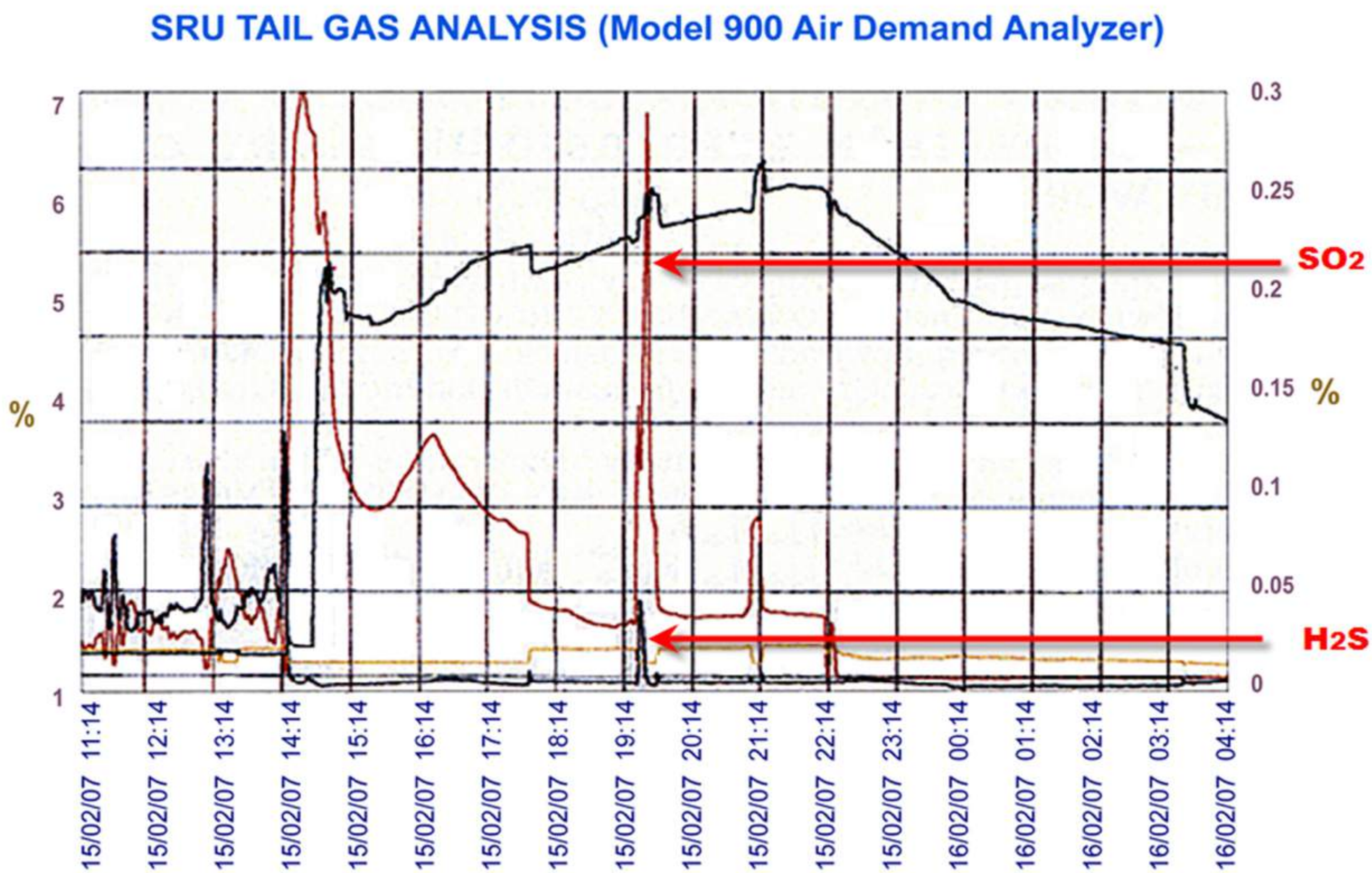
Ratio vs Excess H_2S vs Air Demand

- Ratio is the non linear expression of
  $2\ H_2S\ /\ SO_2$
- Excess H_2S is the linear expression of
  $[H_2S] - 2[SO_2]$ = -1%…0…+1% **H_2S**
- Air Demand uses a scaling factor
  $AD\{2[SO2] - [H_2S]\}$ = -5%...0...+5% **AIR**
  (*AD* factor is nominal 3.5)

Tail Gas: Efficiency as a Function of Excess Air

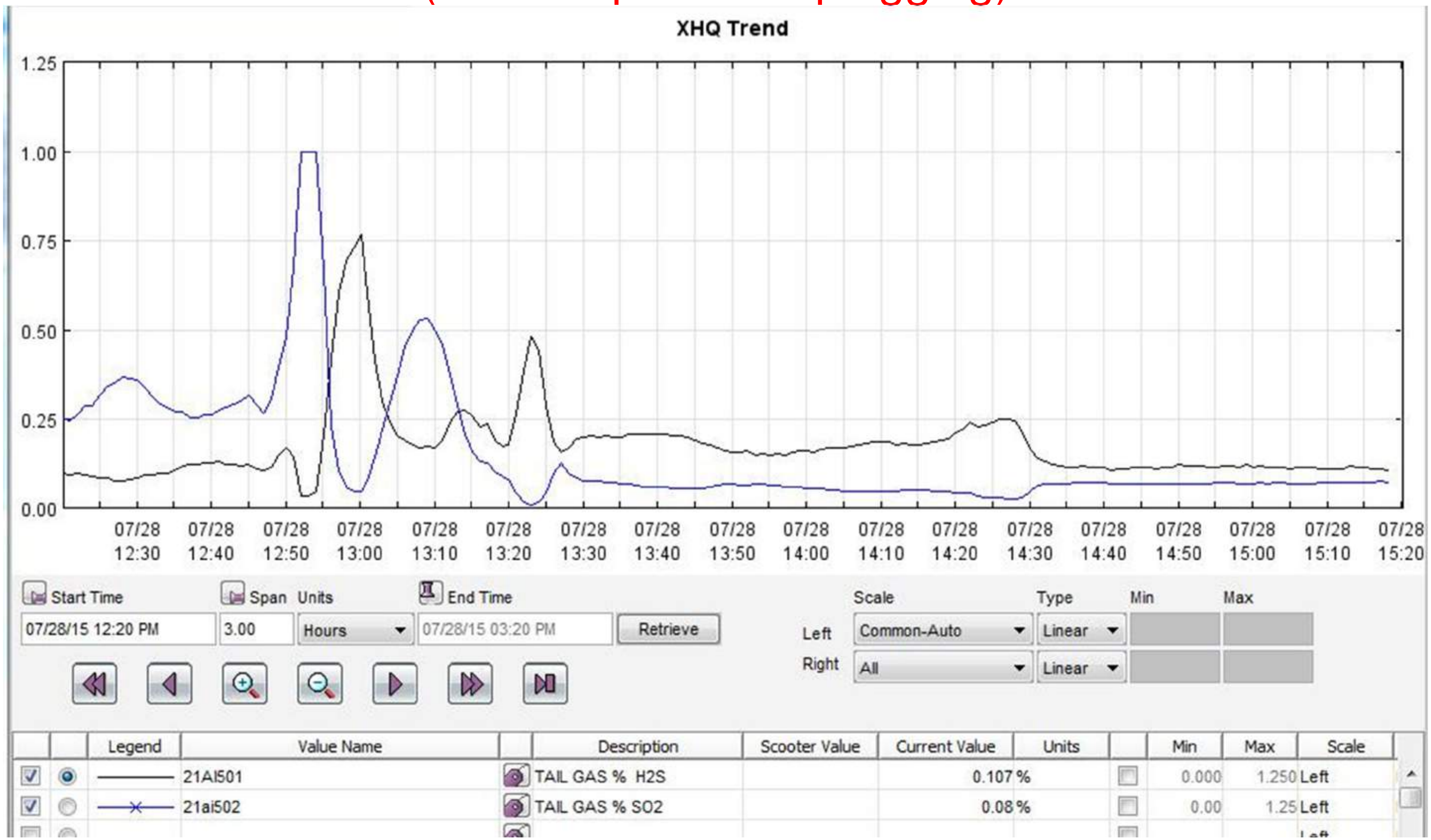


Tail Gas: Process Upset & Over-Range Event

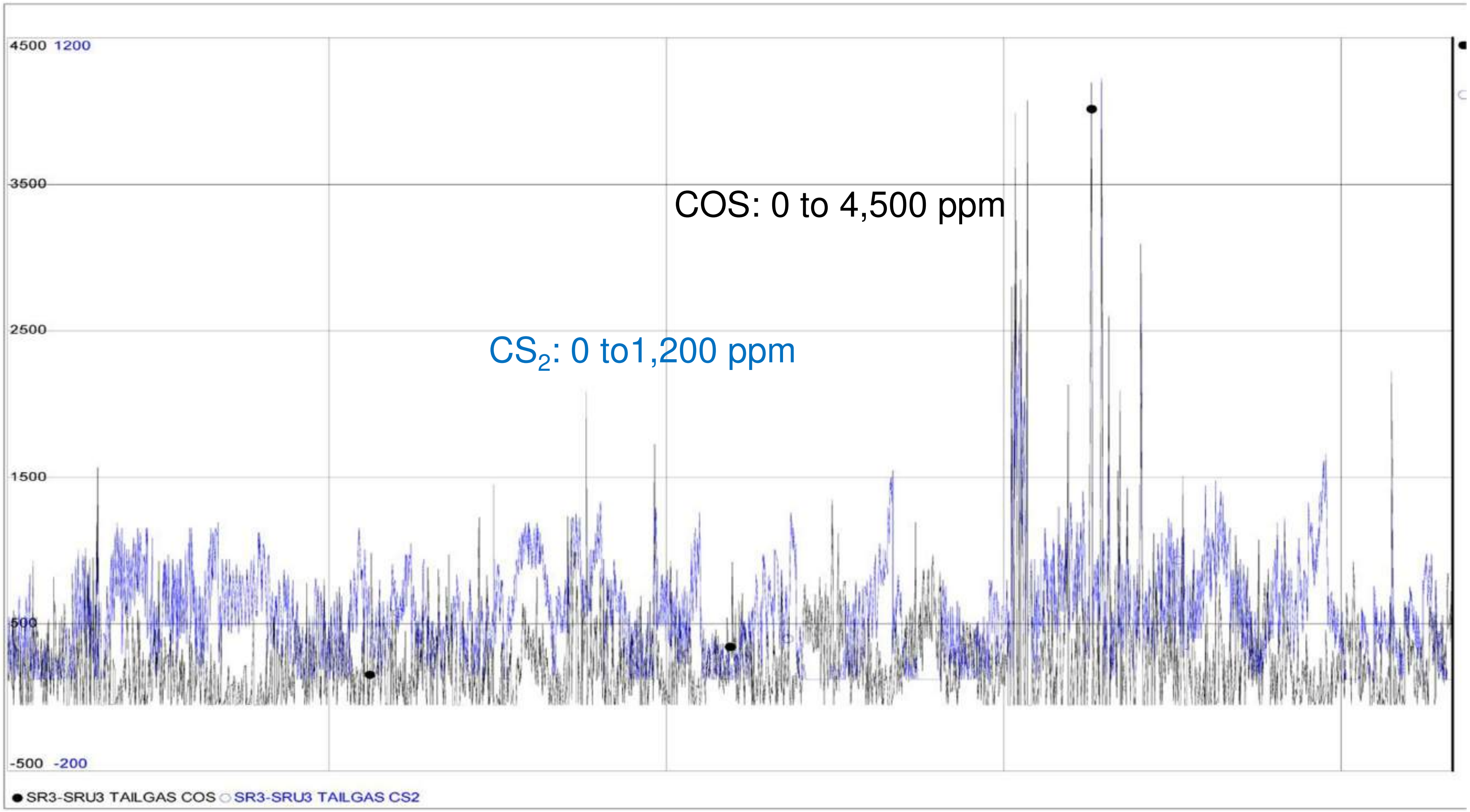


SRU at Turndown

(slow response vs plugging)



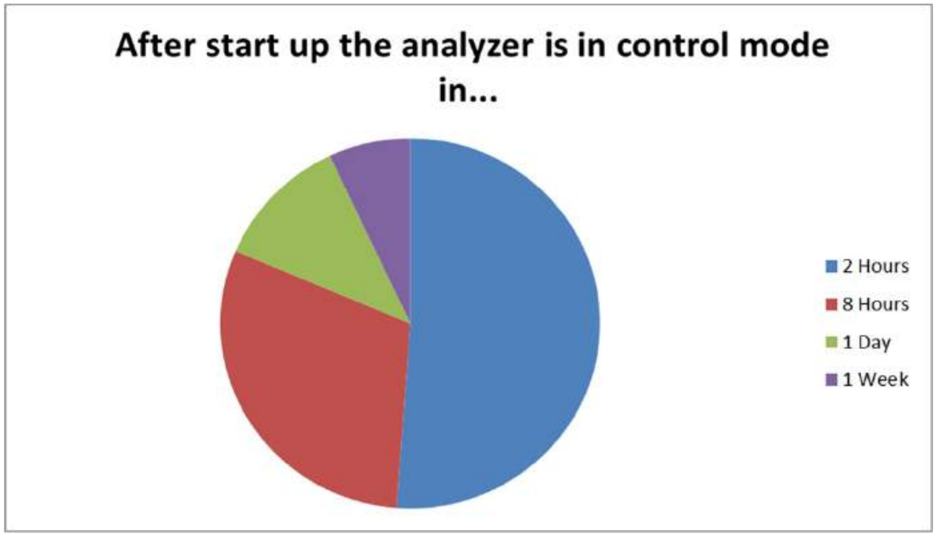
COS & CS_2 in SRU Tail Gas



Putting the Analyzer in Control After Start-up

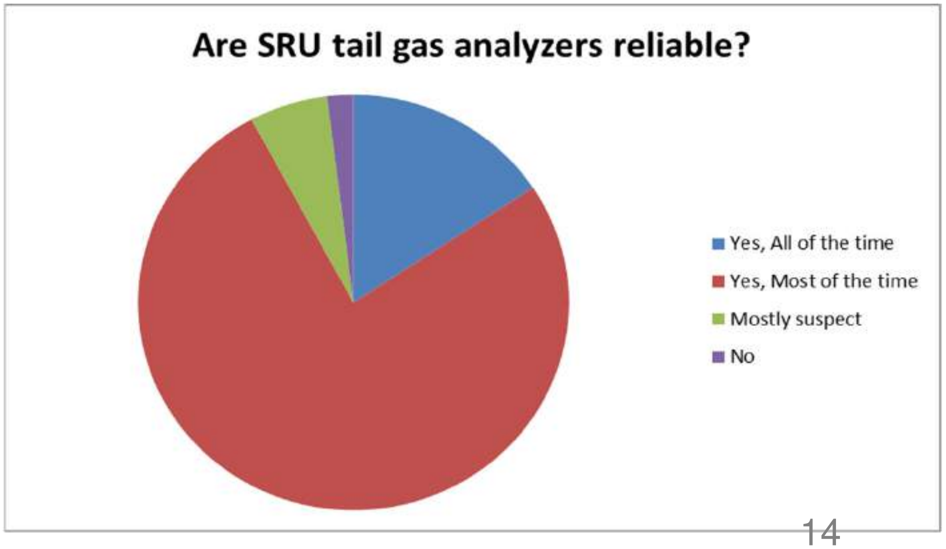
"After start up when is the analyser put into control mode ?"

- Catalyst preference for H2S over SO2 can skew true air control.
- Sulphur Experts recommends control mode after 8 hours.



"Do you consider tail gas analysers to be reliable ?"

- Thankfully yes was common response
- Responses capture the evolution of the tail gas products.
- Time for a 3rd generation.



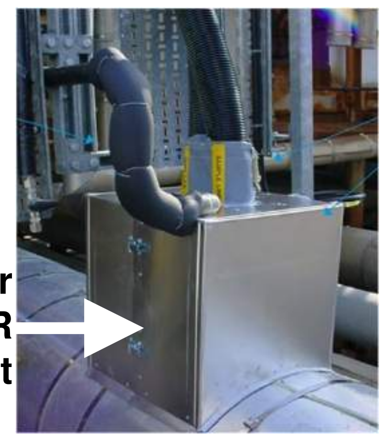
Tail Gas / Best Practices

Top of the Pipe Analyzer

Insulated steam jacketed nozzle

Sample Line Analyzer
900 ADA

Weather cover for ASR probe and jacket



Tail Gas Best Practices / Weather Protection

"Each 10C increase in operating temp above 25C reduces mean electronics component operating life by 50%"

Tail Gas "Sample Line" / Best Practices

Installed at 45° between Cd4 & RGG
(bad piping design…good installation)

Slope the sample line, no pockets

Tail Gas Analyzer / Summary

- Heat integrity at the sample point is paramount
  - Regulated MP steam is best, trapped LP if a must
  - Solve heat integrity problems with Conto-Trace (do not wrap tubing around a nozzle (which does not work)
- Observe the H_2S/SO_2 indicating outputs
  - They can give non predictive results
  - When the analyzer is moving…its working
- Connect the analyzer into the AIT data network

AT-5/6/7 (TGTU)

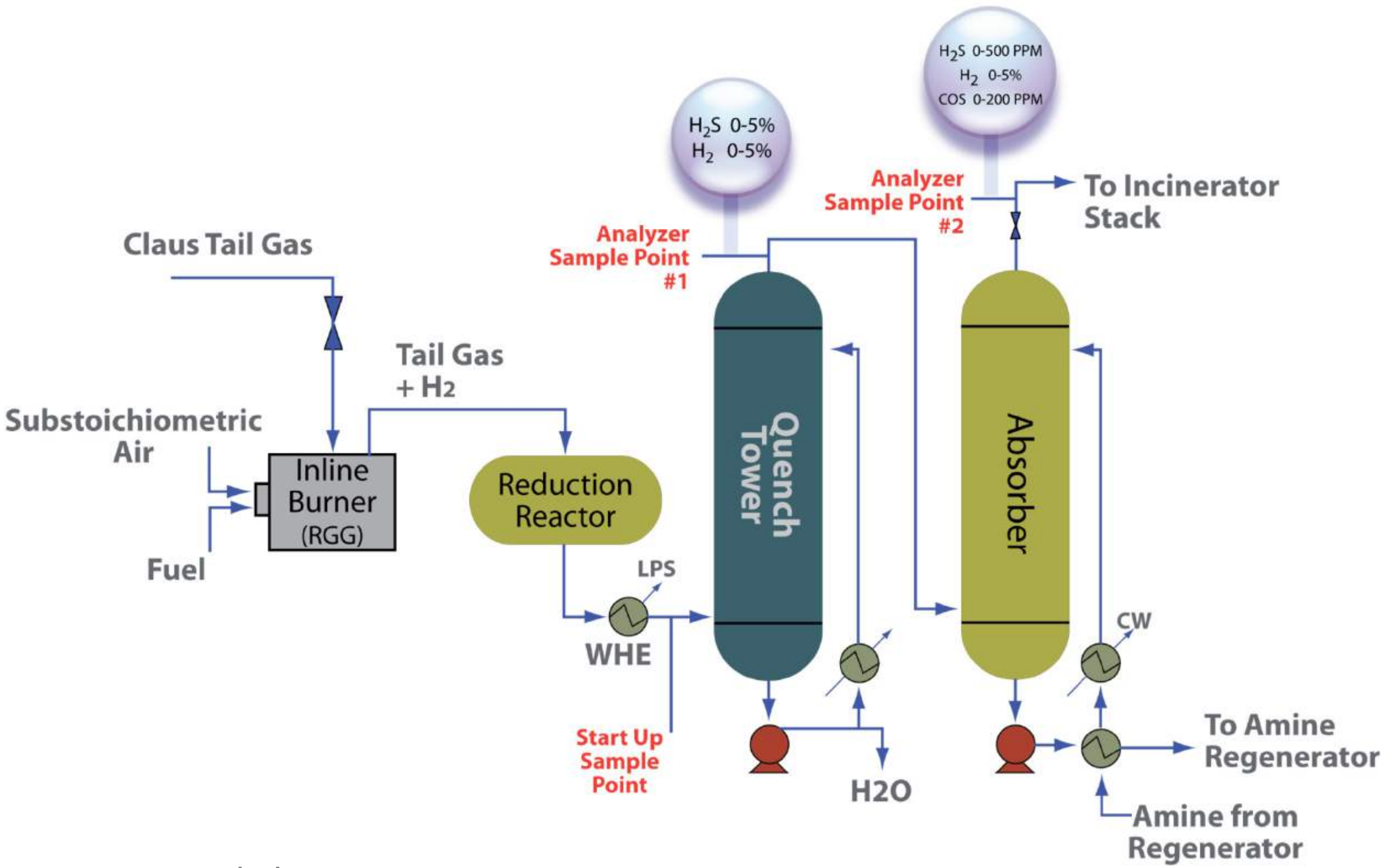
H_2 / H_2S

(COS / SO_2)

Analytical Measurements on a TGTU

- The critical (gas) measurements are **H_2 and H_2S**
- COS is a secondary measurement in combination with H_2 + H_2S
- CS_2 for certain applications but COS considered more important
- SO_2 can be measured at the quench inlet or outlet (not common)
- pH is measured in the quench water (not addressed here)

Amine-Based Tail Gas Treating Unit



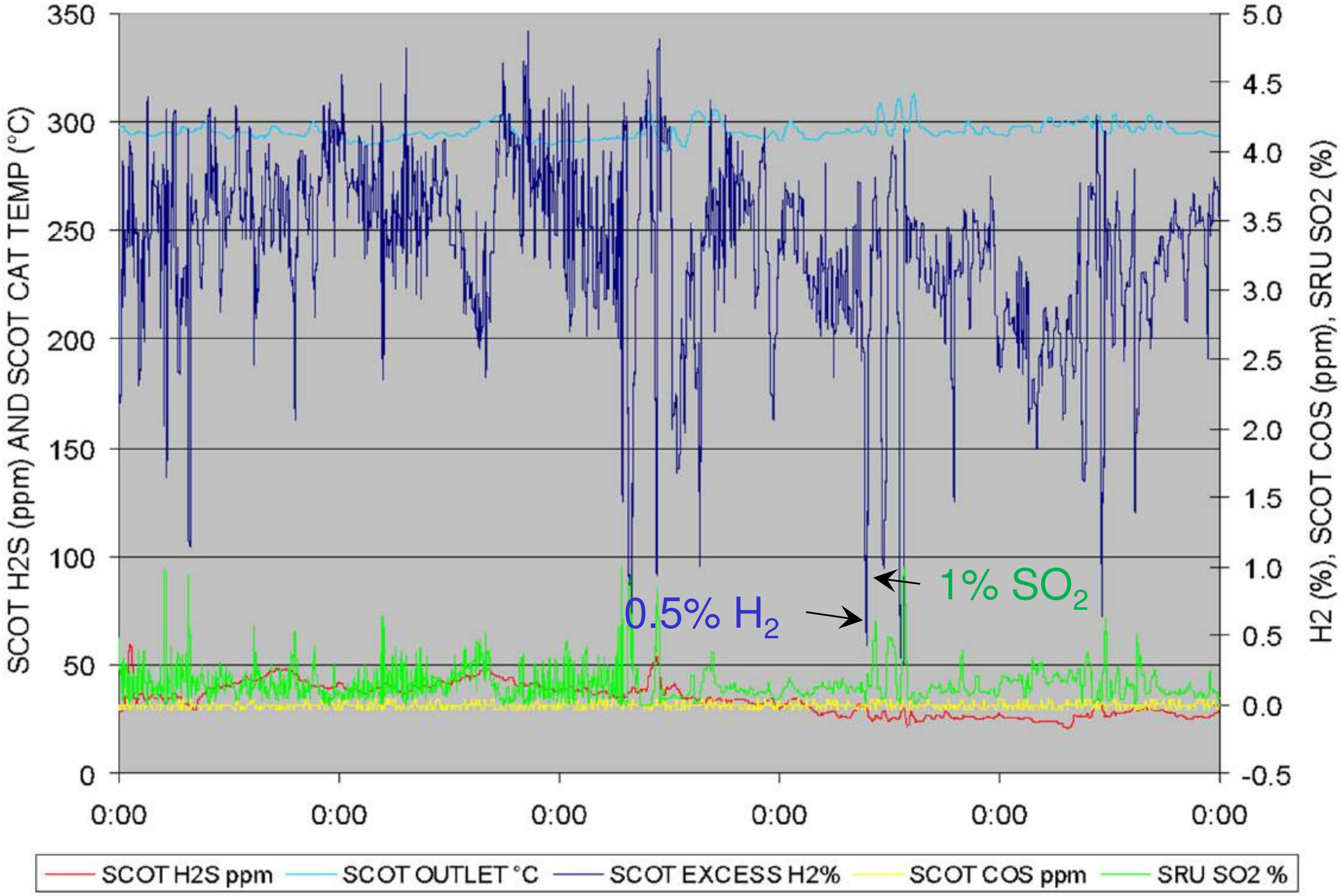
Ranges for H_2S/COS/CS_2 Location for H_2 Measurement

- Optimal analytical ranges
  - [H_2S] > [COS] > [CS_2] generally exist in < concentrations
  - Ranges subject to spectroscopy matrix, optimal ranges are;
    - H_2S 0-100 ppm (up to 0-500 ppm FSR depending on permit levels)
    - COS 0-200 ppm
    - CS_2 0-50 ppm

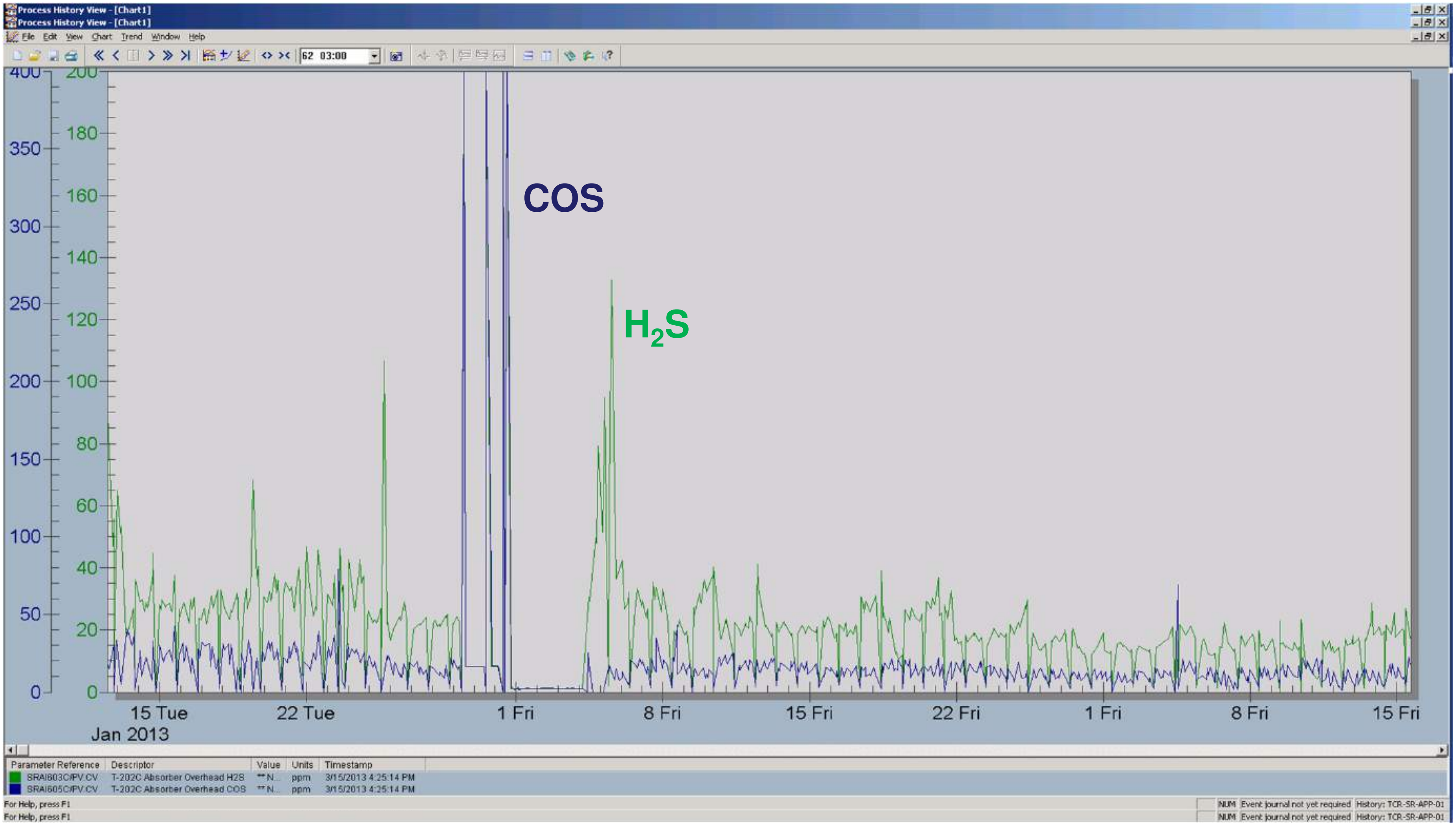
- H_2 sample point location when there are 2 analyzers
  - Locate the H2 measurement at the Absorber outlet (slightly cleaner)
  - If using Flexsorb locate the H2 measurement at the Quench outlet

HAG Particulate Filter After SO_2 TGTU Upset

Low H_2 (TGTU) vs High SO_2 (Tail Gas)



TGTU (COS & H_2S) Steady State & Upset



TGTU Analyzer Summary

- A H_2 / H_2S analyzer is critical to the operation of a TGTU
- When replacing a legacy H_2/H_2S analyzer add the COS/CS_2 measurements
- If there is a diverter valve have a "start up" sample point
- If there is an analyzer at both the Quench and Absorber outlet put a H_2 sensor at both locations
- This survey is based on~190 analyzers
  - Of which ~150 are at Abs outlet, ~35 at Quench outlet. ~5 at Quench inlet

AT-8 (Emissions)

SO_2

SO_2 Mass Emission

(H_2S, O_2, NOx)

Other Parameters

- SO_2
  - Dual range for TGTU bypass periods
- H_2S
  - Measurement of residual value after incineration (~10 ppm)
  - The part of EPA sub-part J(a) that was not promulgated
  - Accounting for un-combusted reduced S compounds by oxidizing the residual H_2S to SO_2
- O_2
  - Stand alone analyzer or on board with CEMS SO_2 analyzer
  - Combustion control can only be done with stand alone
- NOx
  - NOx values are low, not normally required

Emission Analyzers

- "The Color of Plumes"
  - White: Steam plume caused by water condensation (cold, Canada)
  - Bluish white: SO_3 plume usually caused by high SO_2 emissions
  - (….Confirmed by "Green Slime" in the CEMS sample system)
  - Orange: NO_x plume
  - Brown: Unburned hydrocarbon / soot plume
  - Green: Burning H_2S plume

AT-2 (O_2 / SRU Start up)

O_2

(CO, Combustibles)

Process Oxygen Measurement

- For start-ups and shut-downs of the SRU
  - Requires excess O_2 to near stochiometric conditions of 0.1% xs air
- Measurement typically done by operators using portable unit
  - Safety considerations: exposure of personnel during start up
  - SRU-TGTU tend to be all at one time and not in sequence
- A fixed (permanent) system can consist of;
  - Laser based “non contact” type analyzer (capable of sampling into “Claus” mode but shut-in after transition to “Claus” mode)
  - Isolated between start ups with "ASR" probes

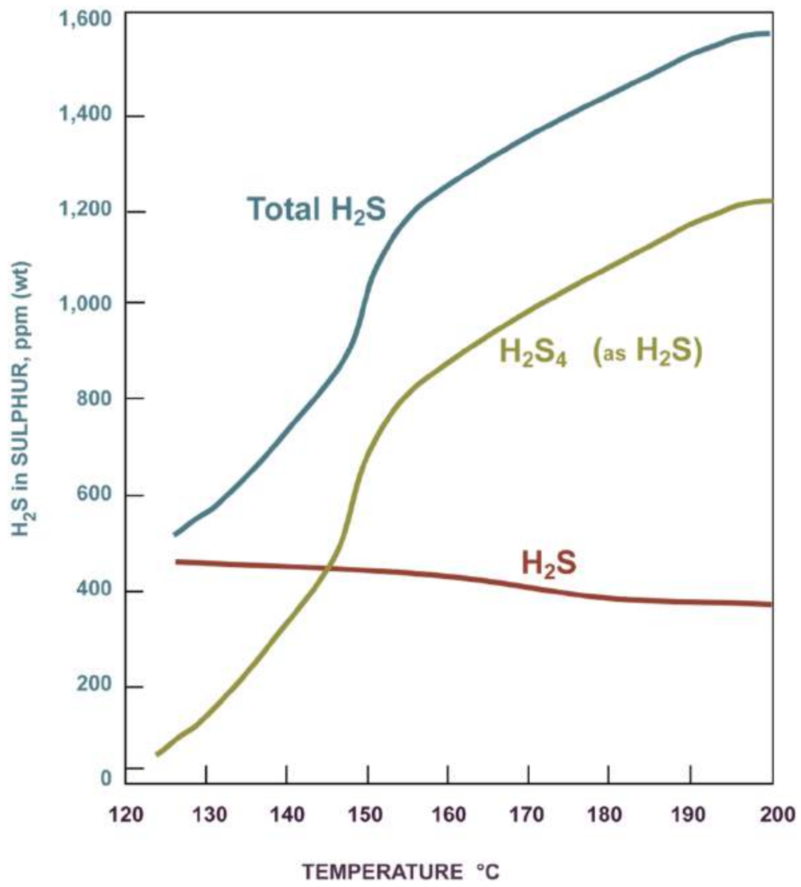
AT-3 (Sulfur Pit)

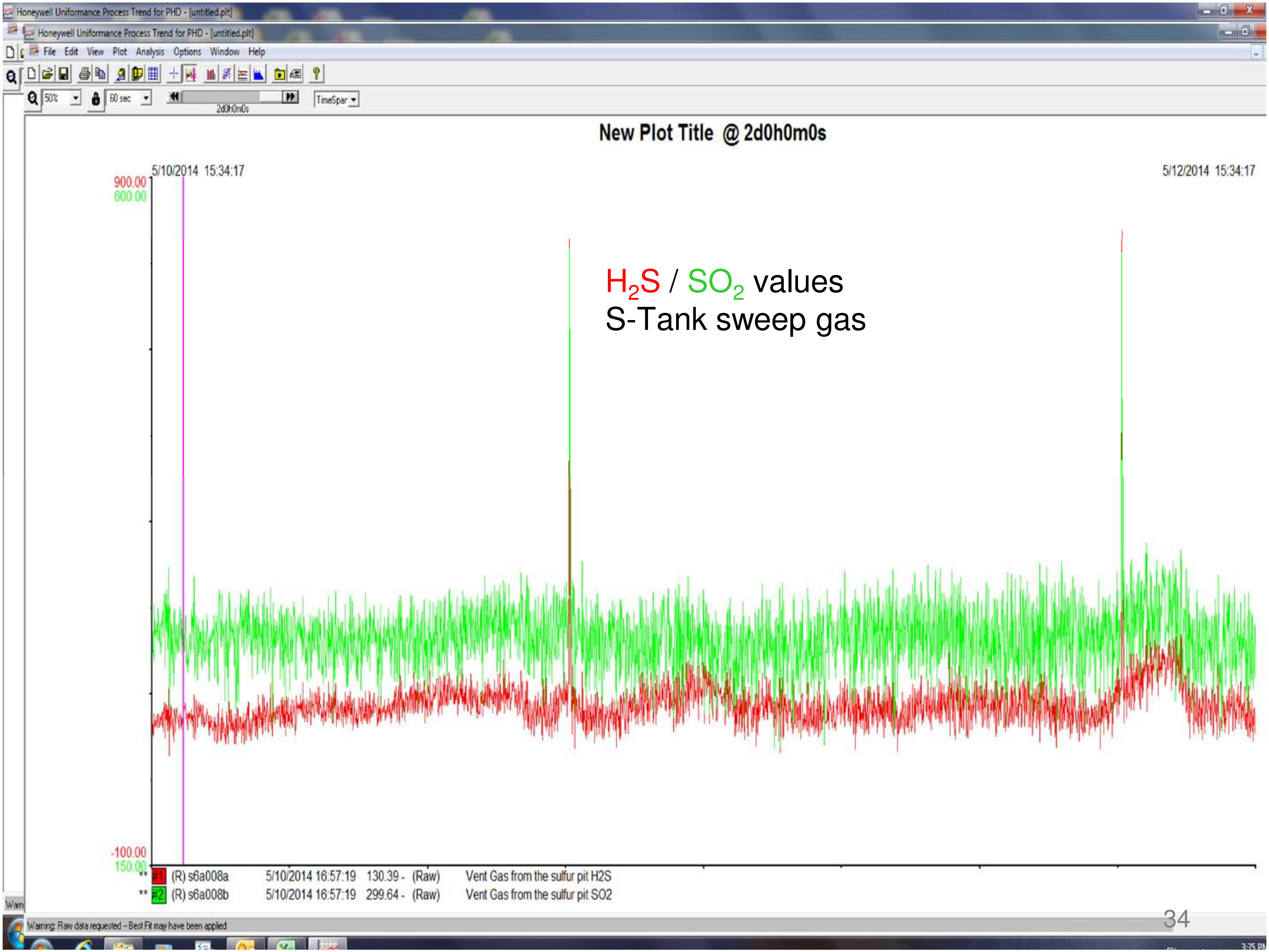
H_2S (LEL)

SO_2 (Pyrophoric sulfur fire)

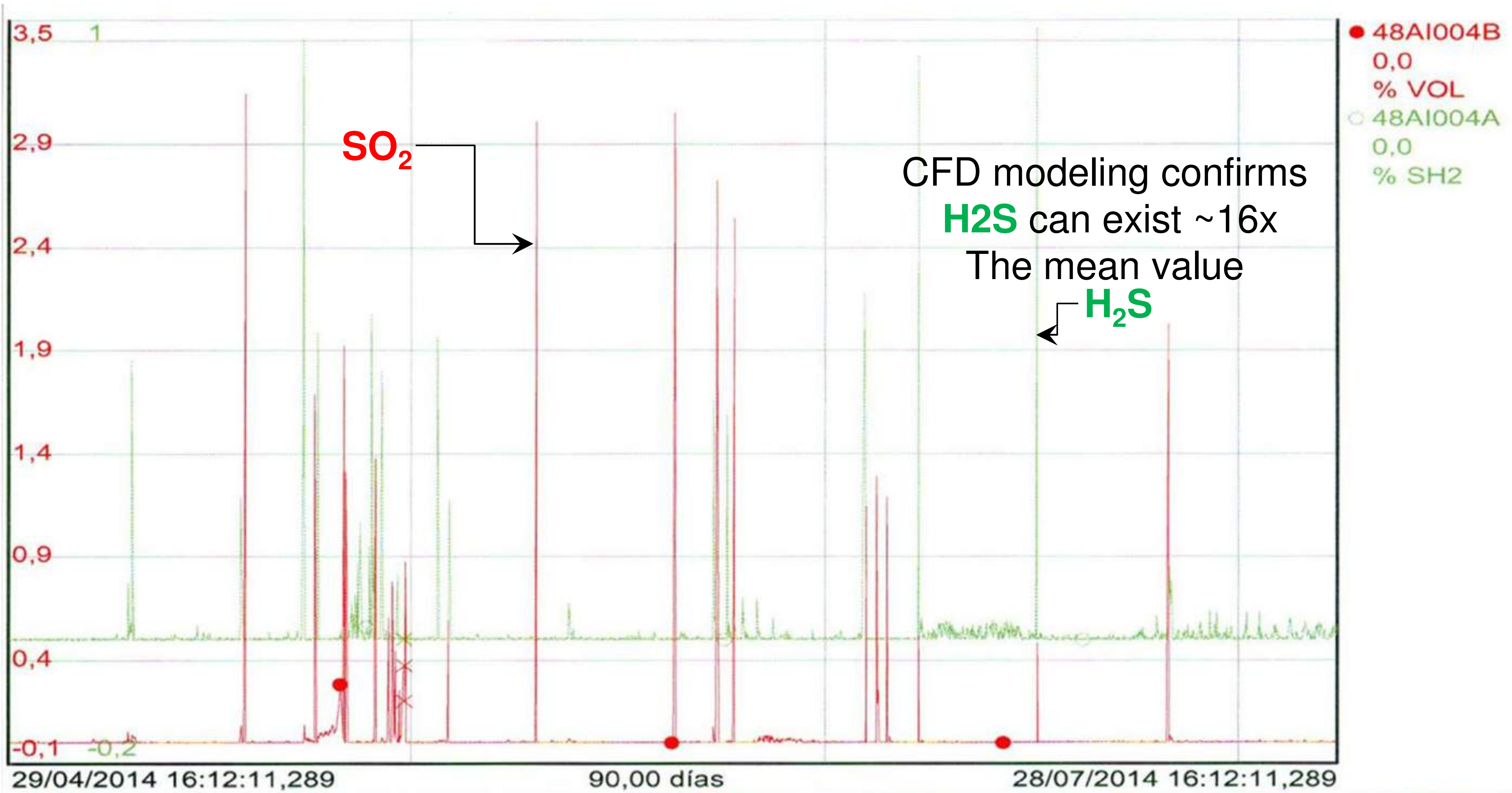
Sulfur Pit Gas: Solubility of H_2S in Sulfur

- Produced sulfur has ~600 ppm of dissolved H_2S + hydrogenpolysufide
- Spontaneous degassing and concentration in the gas phase can increase to explosive levels (3.25%)
- Pit gas analyzer requires same sample integrity as tail gas analyzer
- H_2S is measured to warn of LEL, SO_2 is measured to warn of S-fire
- Used to quantify addition to emissions (Pit can be1/3rd or more of emissions)




Honeywell Uniformance Process Trend for PHD - [untitled.plt]
File Edit View Plot Analysis Options Window Help
New Plot Title @ 2d0h0m0s
5/10/2014 15:34:17
5/12/2014 15:34:17
900.00
600.00
-100.00
150.00
H_2S / SO_2 values
S-Tank sweep gas
#1 (R) s6a008a 5/10/2014 16:57:19 130.39 - (Raw) Vent Gas from the sulfur pit H2S
#2 (R) s6a008b 5/10/2014 16:57:19 299.64 - (Raw) Vent Gas from the sulfur pit SO2
Warning: Raw data requested – Best Fit may have been applied

Sulphur Pit High H_2S & SO_2 Values (Just prior to an incident)



Maintenance: Analyzer Categories

Complexity Factor Category	Type of Analyzer	Estimated PM (h/month)
1. (Simple)	pH, Conductivity, Gas Detection, O_2	2
2.(Physical Property)	Boiling Point, Flash Point, Freeze Point, RVP, Viscosity	3
3.**(Environmental)**	CEMs SO_2, CO, Opacity, ~~H_2S~~	2.5
4.**(Complex)**	Tail Gas, GC, Mass Spec, NIR, FTIR, H_2S	4

Outside Training

Courtesy of Chevron ETC, Analyzer Engineering Group

Q&A

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