AMETEK®

AMETEK®
PROCESS INSTRUMENTS

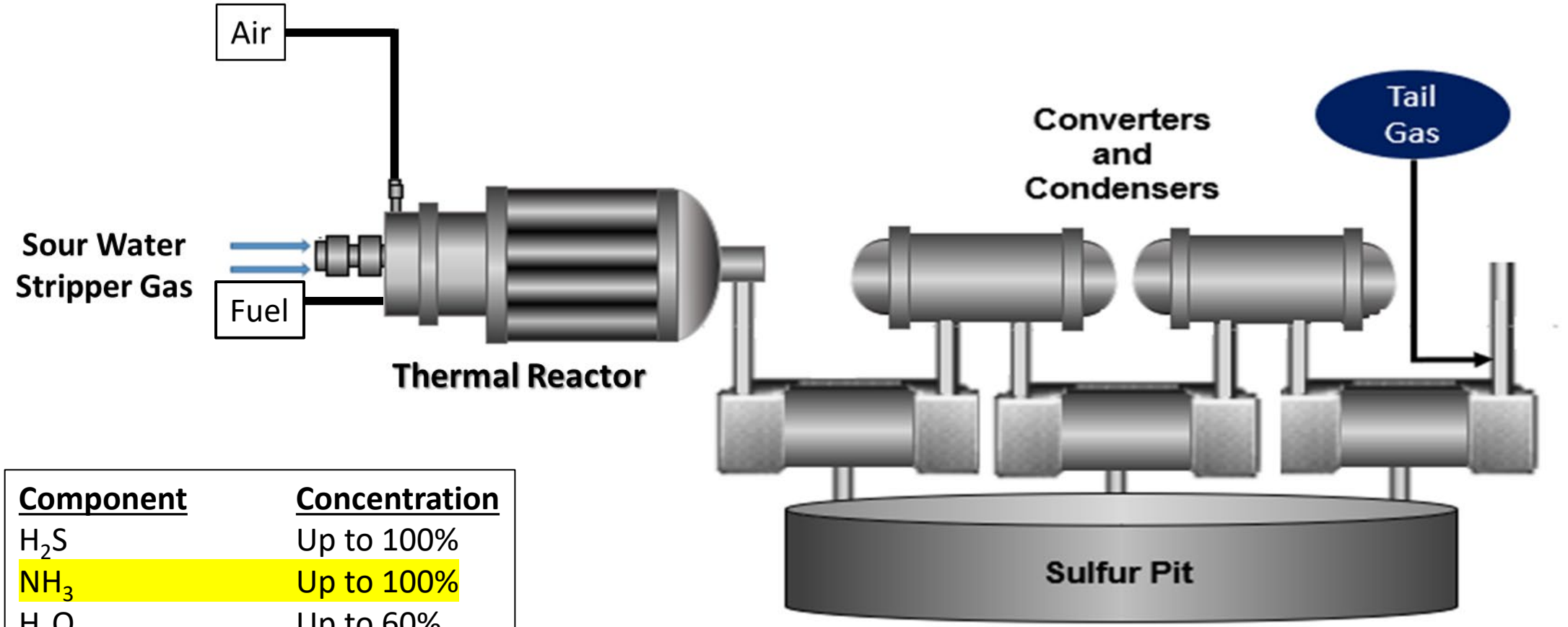
SEPTEMBER 2025

CHALLENGES ASSOCIATED WITH AMMONIA PRESENCE AND MEASUREMENTS IN SULFUR RECOVERY UNITS

BRIMSTONE SULFUR SYMPOSIUM 2025

MICHAEL GAURA (AMETEK PI)

AMMONIA IN CLAUS PLANTS

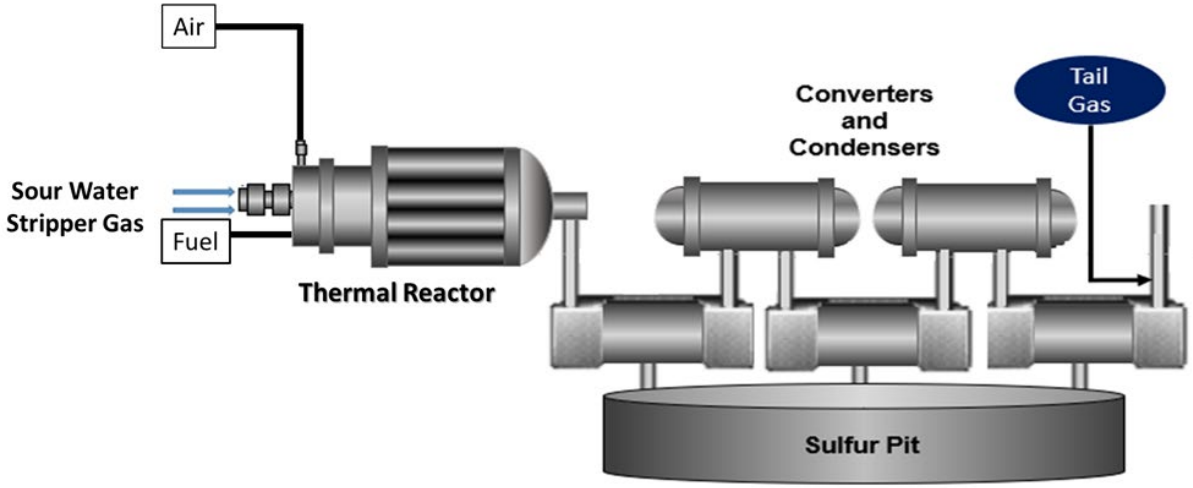


Component	Concentration
H_2S	Up to 100%
NH_3	Up to 100%
H_2O	Up to 60%
THC	Up to 10%
CO_2	Up to 50%

AMMONIA IMPACTS ON SRU PERFORMANCE

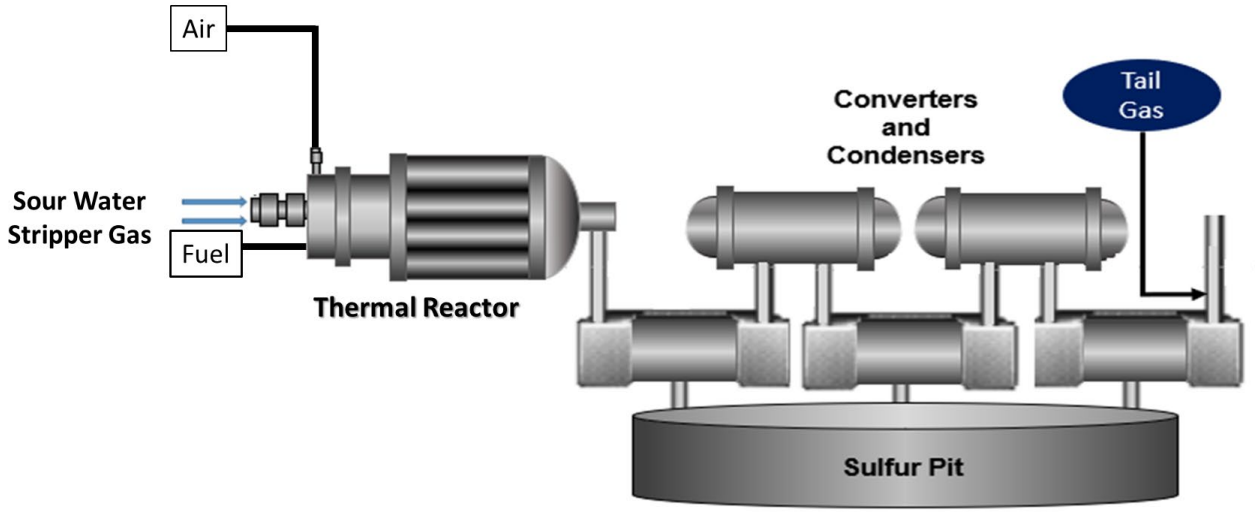
- Ammonia salts can build up in condensers and SRU cold spots.
  - The condensers are a “cold spot” in the SRU process
- Reduction in SRU capacity
- Ammonia can even carry over to a TGTU

Photo Source: Sulphur Magazine: January 2011 and Sulphur Experts



AMMONIA DESTRUCTION

- Takes place in the thermal reactor
- Requires high temperatures
  - 2280/2375/2460/2550 °F
  - 1250/1300/1350/1400 °C
- Requires adequate mixing in the thermal reactor



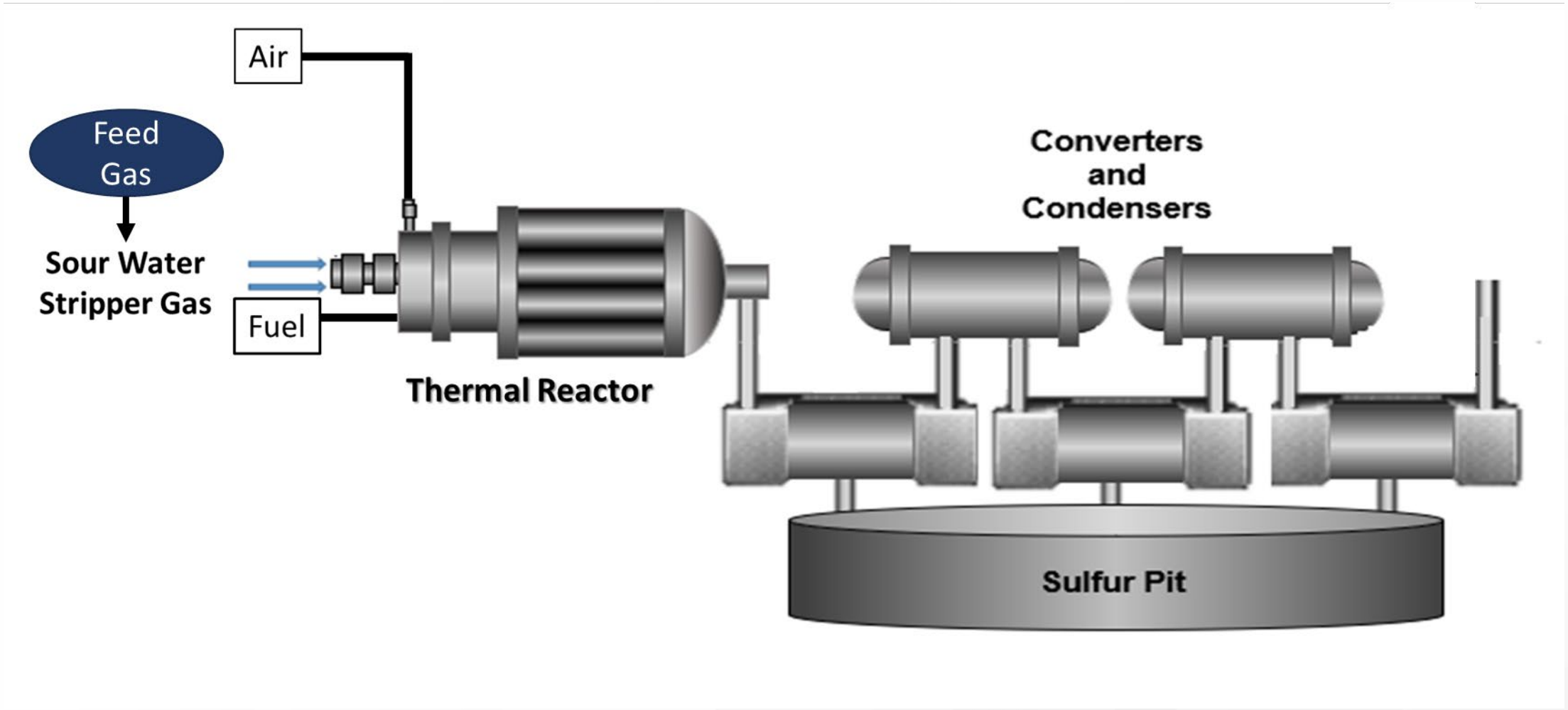
$$2\ NH_3 + 3/2\ O_2 \rightarrow N_2 + 3\ H_2O$$
$$2\ NH_3 \rightarrow N_2 + 3H_2$$
$$2\ NH_3 + SO_2 \rightarrow N_2 + 2\ H_2O + H_2S$$

Courtesy ASRL

AMMONIA IMPACTS ON SRU ANALYZERS

- The analyzer tends to be one of the coldest “spots” in the SRU
- Ammonia salts can build up in filters and/or demisters, resulting in flow restrictions
- Build up can occur on cell windows
- Use of steam blowback and periodic maintenance of the cells can limit the impact

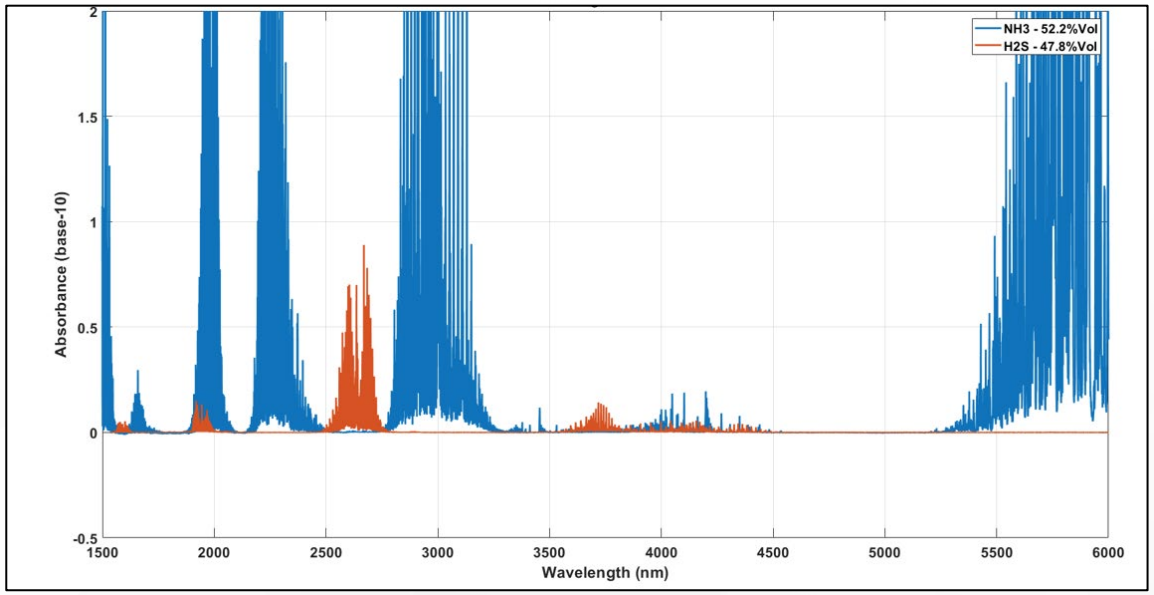
AMMONIA MEASUREMENT POINTS

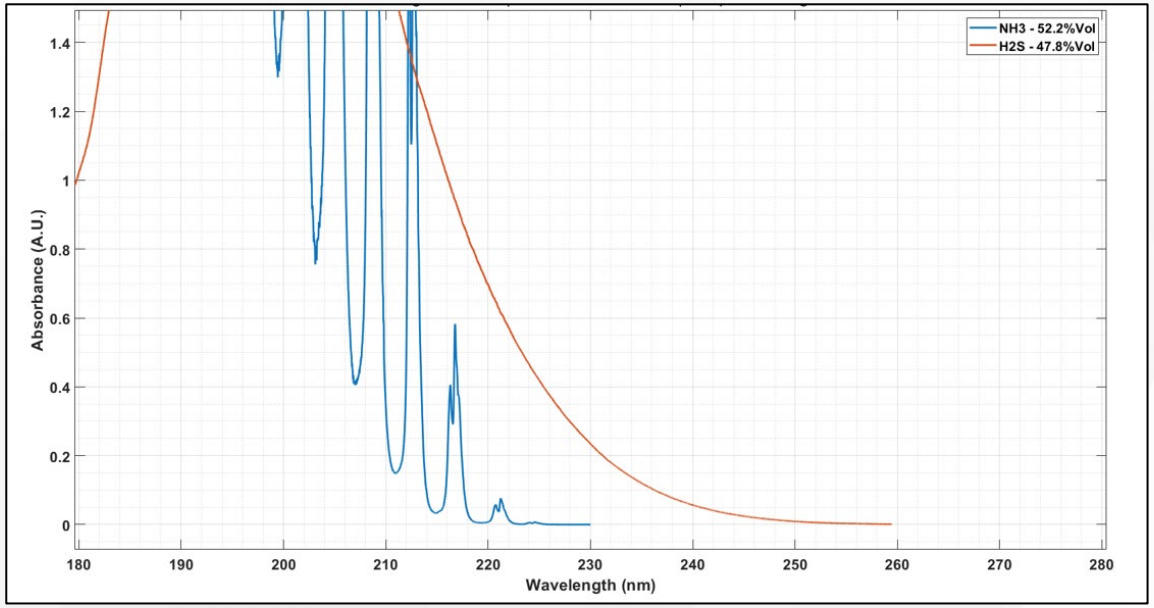


MEASUREMENT REQUIREMENTS AND CHALLENGES – FEED GAS

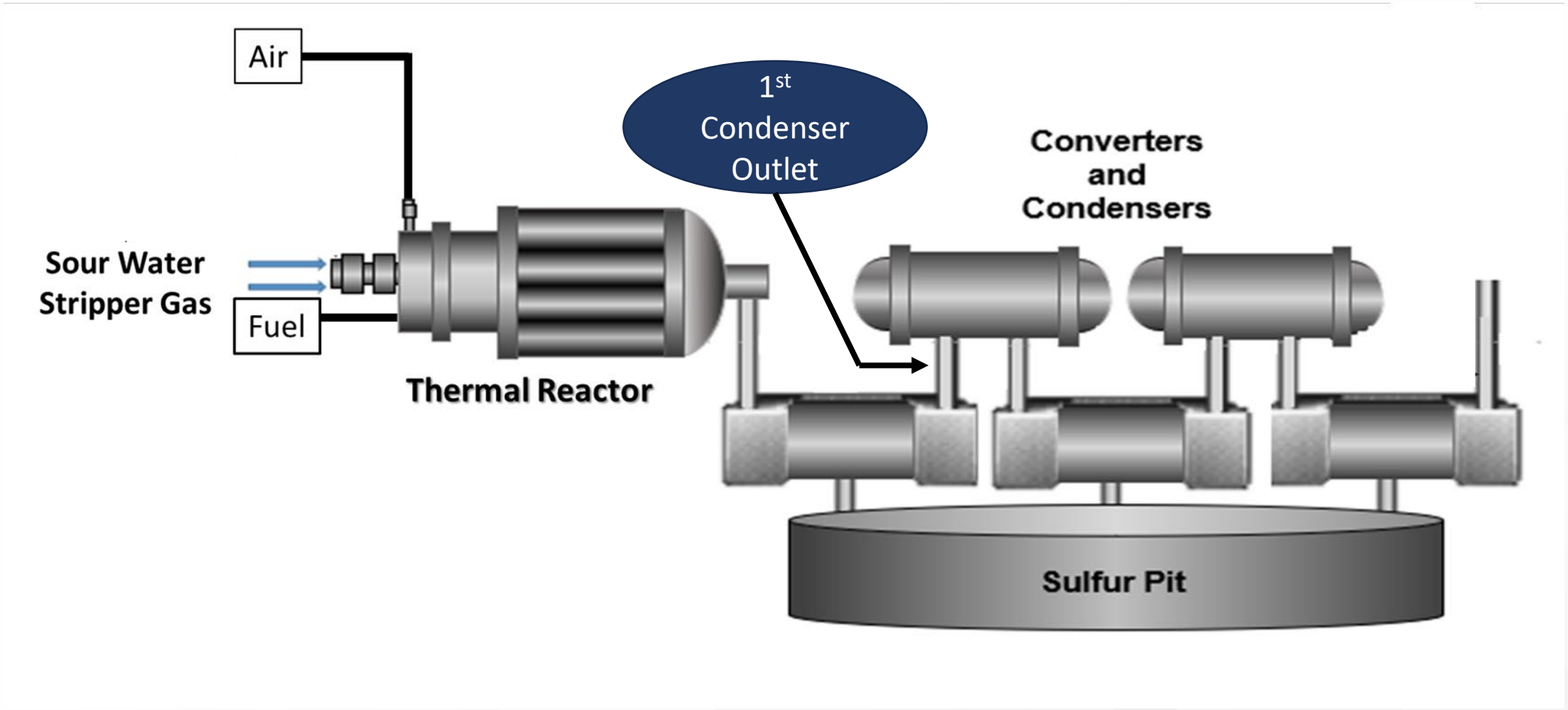
- High % of Ammonia
- Limited Challenges
- Combination of Infrared (IR) and Ultraviolet (UV) optical benches
  - + some junior high algebra
- Safety is a significant concern at this measurement point

Component	Typical Measured Concentration
H_2S	Up to 100%
NH_3	Up to 50%
H_2O	Up to 40%
THC	Up to 10%
CO_2	Up to 10%



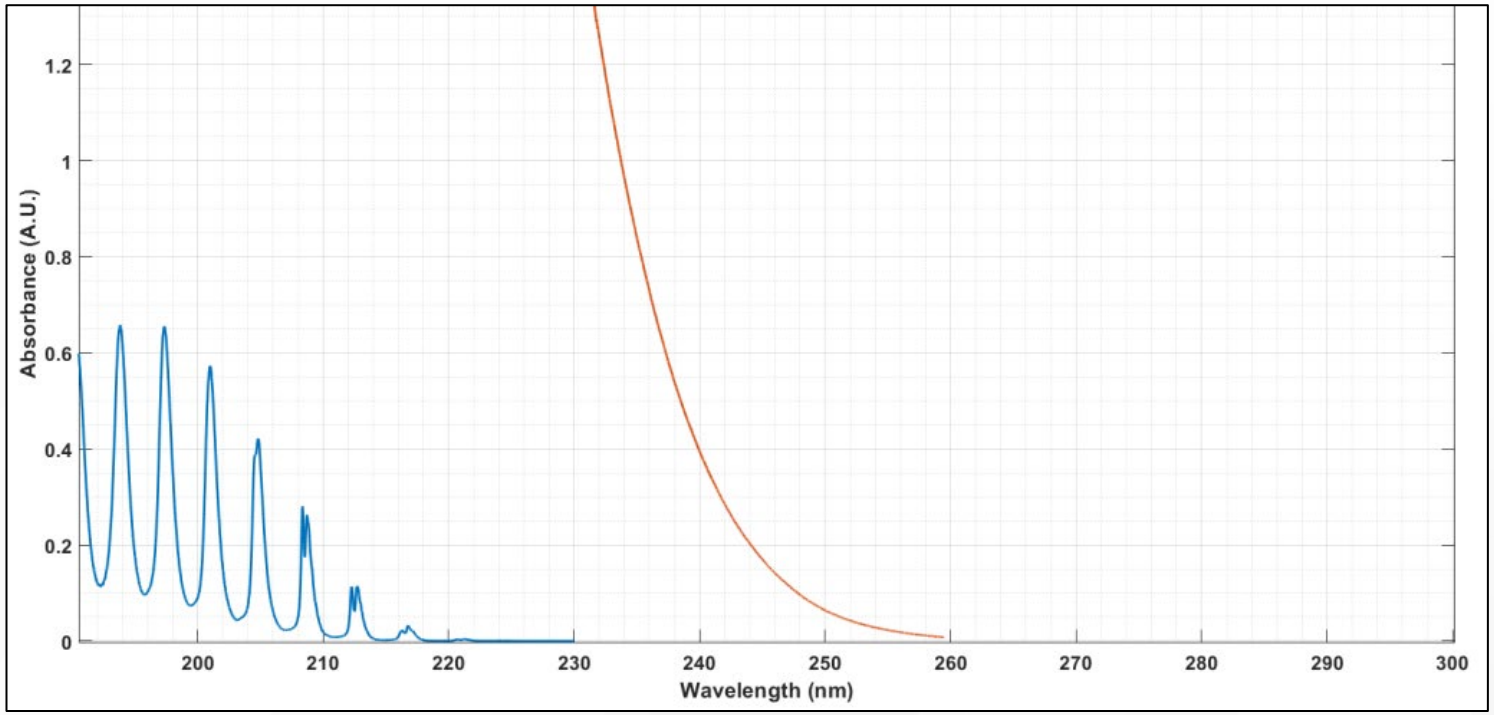


AMMONIA MEASUREMENT POINTS



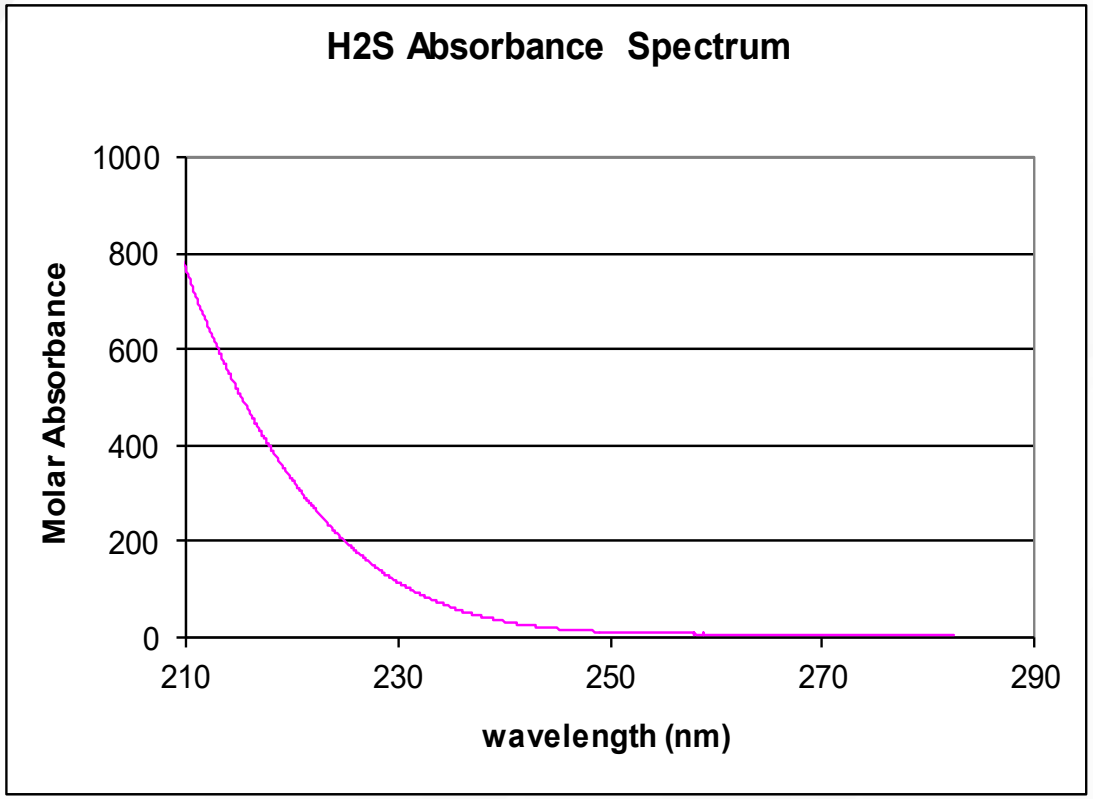
MEASUREMENT REQUIREMENTS AND CHALLENGES – 1ST CONDENSER

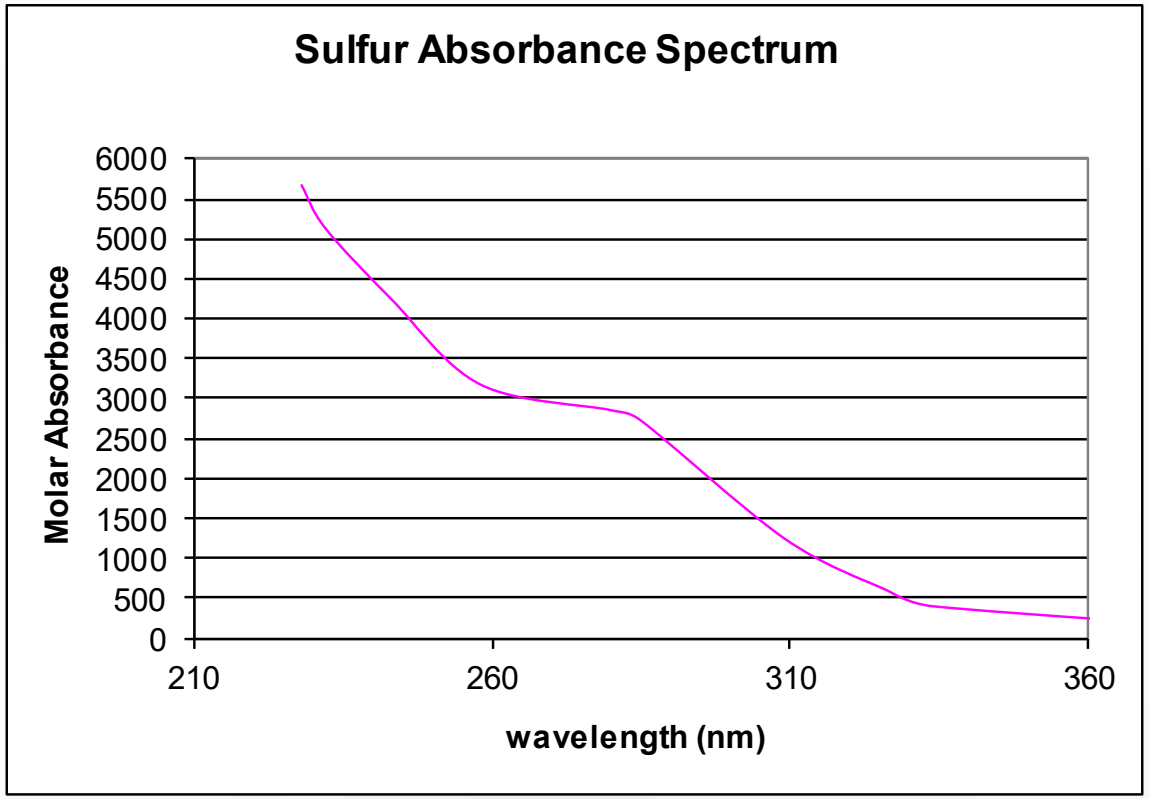
- Low concentration of Ammonia
  - 500 ppm range
- Challenging
- UV measurement of ammonia shows significant interference from H_2S
- Higher levels of elemental sulfur



Component	Requested Measured Concentration
NH_3	Up to 500ppm
O_2	Up to 1%

ELEMENTAL SULFUR IMPACT

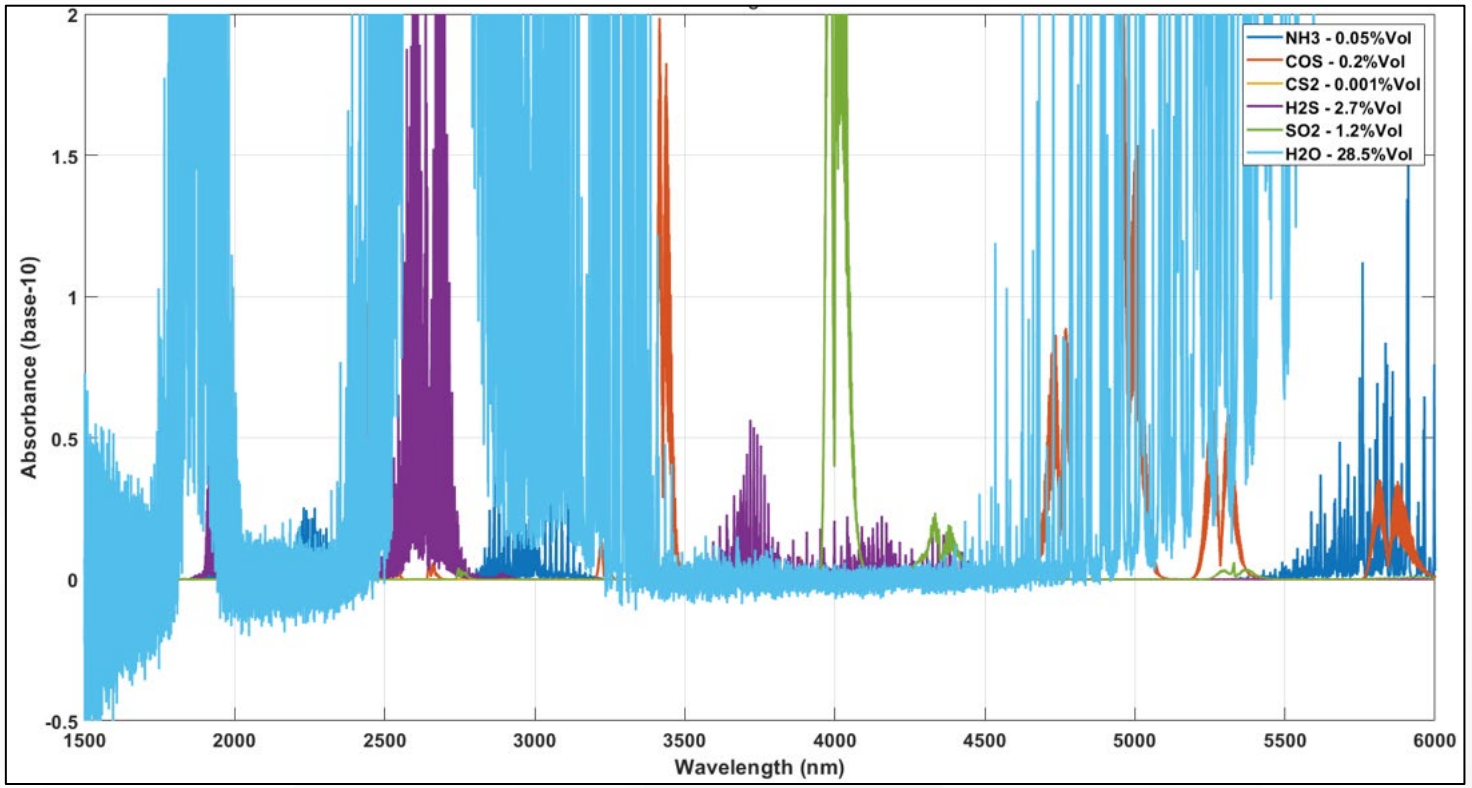




1st condenser is expected to have much more elemental sulfur than what is seen at the Air Demand/Tail Gas Analyzer

MEASUREMENT REQUIREMENTS AND CHALLENGES – 1ST CONDENSER

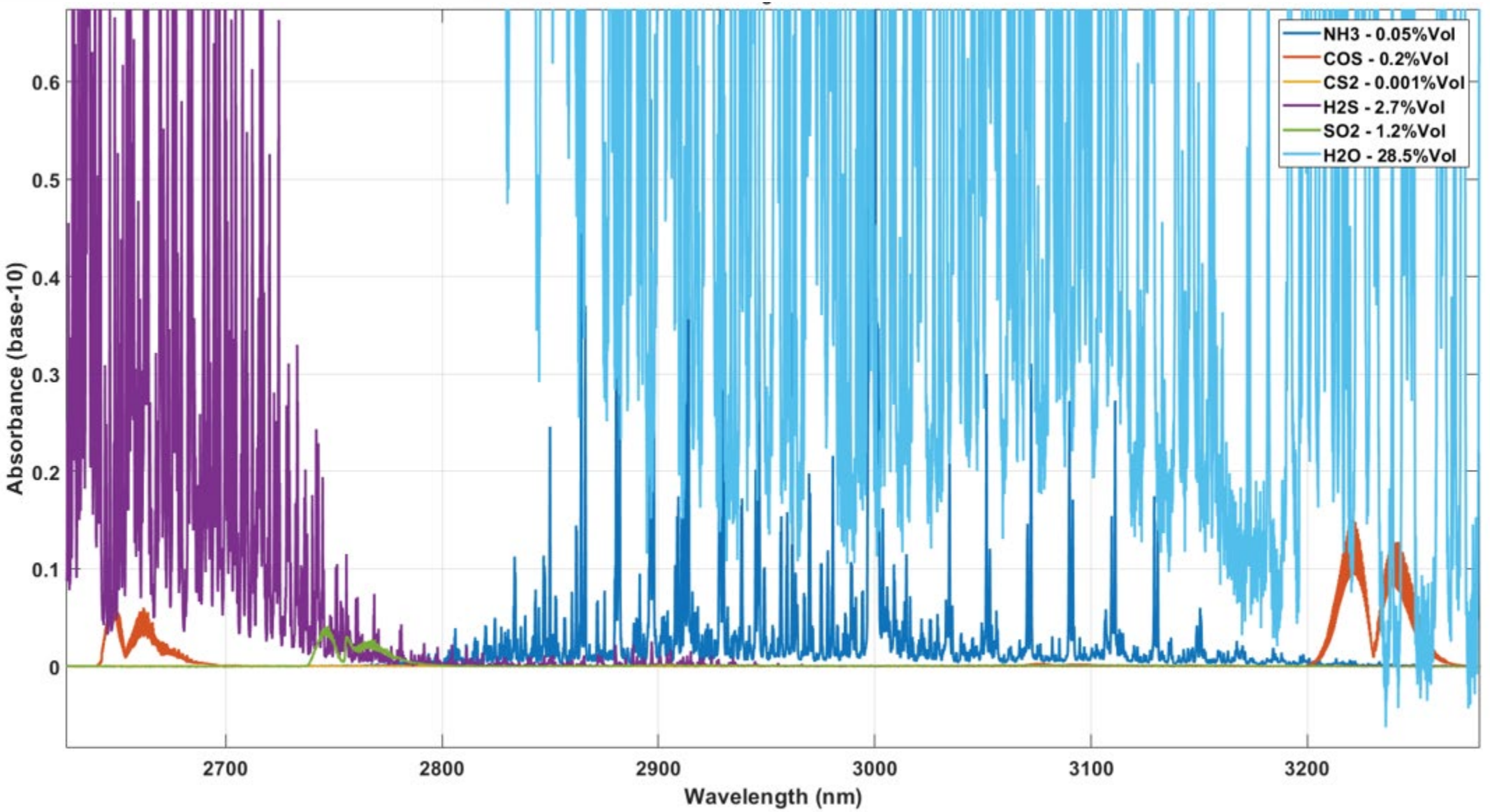
- Low concentration of Ammonia
  - 500 ppm Range
- Baseline absorbance
- High Temperature required
- Can we also measure Oxygen?



14M effective sample path length

Component	Requested Measured Concentration
NH_3	Up to 500ppm
O_2	Up to 1%

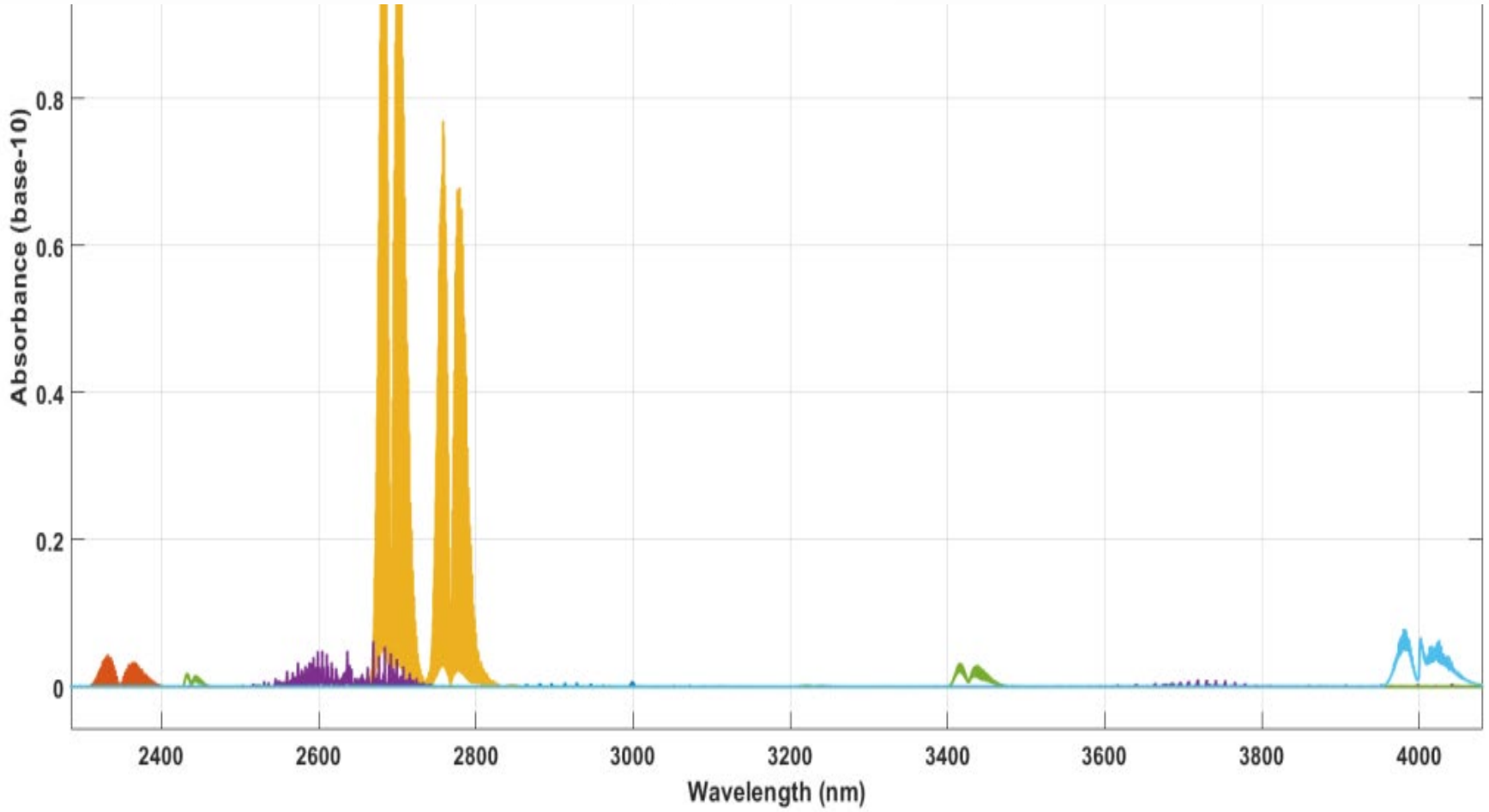
MEASUREMENT REQUIREMENTS AND CHALLENGES – 1ST CONDENSER



14M effective sample path length

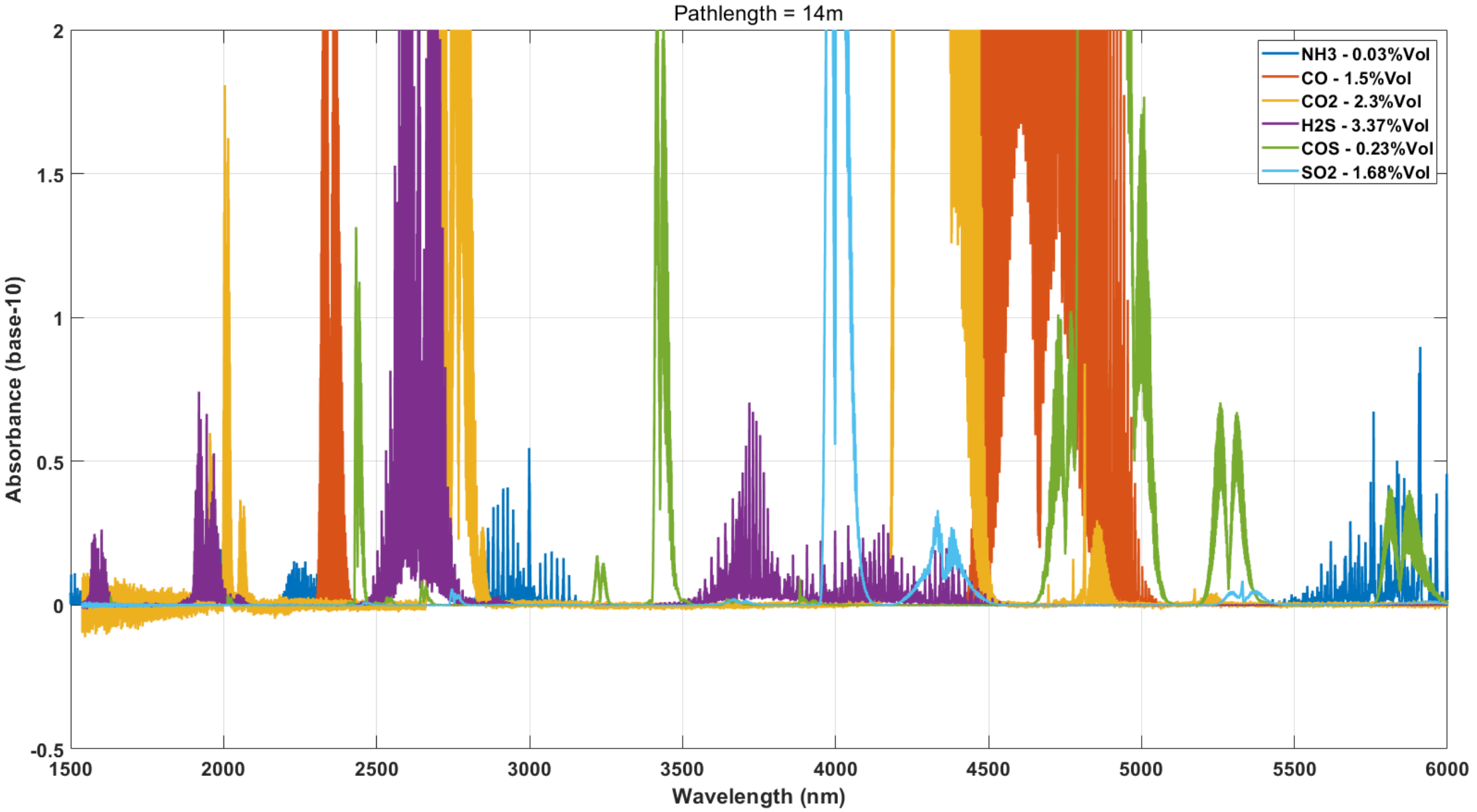
ADDITIONAL CHALLENGES – 1ST CONDENSER

- High Temperature concern removed
- Water removed
  - Loss of ammonia?
- Baseline absorbance is too low



20cm effective sample path length

ADDITIONAL CHALLENGES – 1ST CONDENSER



AMMONIA MEASUREMENT POINTS – AIR DEMAND/TAIL GAS

- Very similar concerns to those mentioned for the 1st condenser measurement points
- Combination with H_2S and SO_2 measurements not currently possible