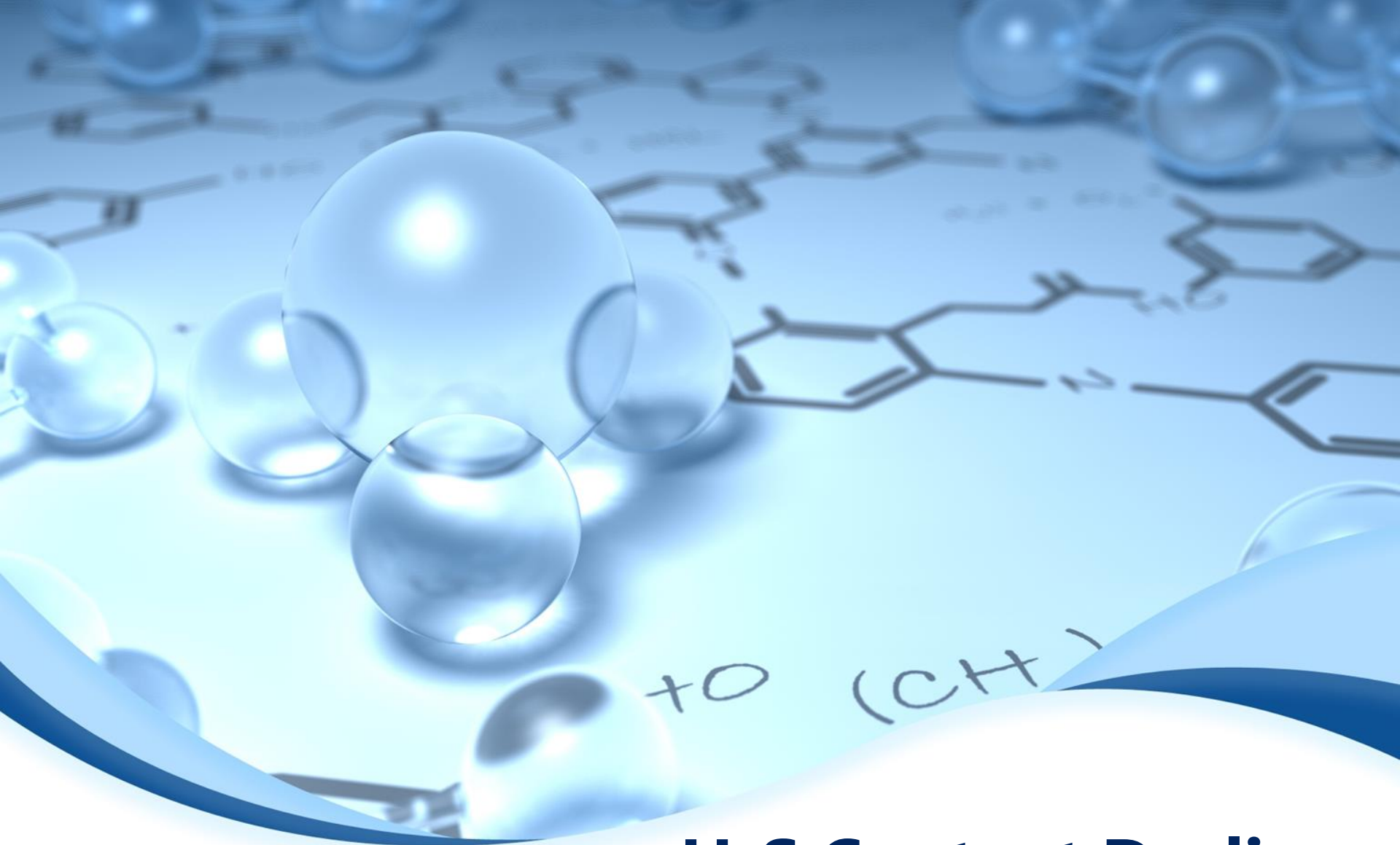


H_2S Content Decline: "What do we do next?"

SULFUR RECOVERY ENGINEERING

Who We Are

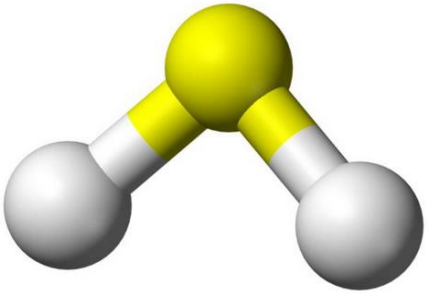
- **Sulfur Recovery Engineering**
  - Established 1998
  - Provide in-field SRU consulting around the world

SRU Reliability, Performance and Protection

- **Virtual Materials Group - VMG Sim®**
  - Uses years of accumulated SRE field data
  - Accurately models and predicts process
  - Used for capacity evaluations, performance evaluations and dynamic process modeling

H_2S content decline: “What do we do next?”

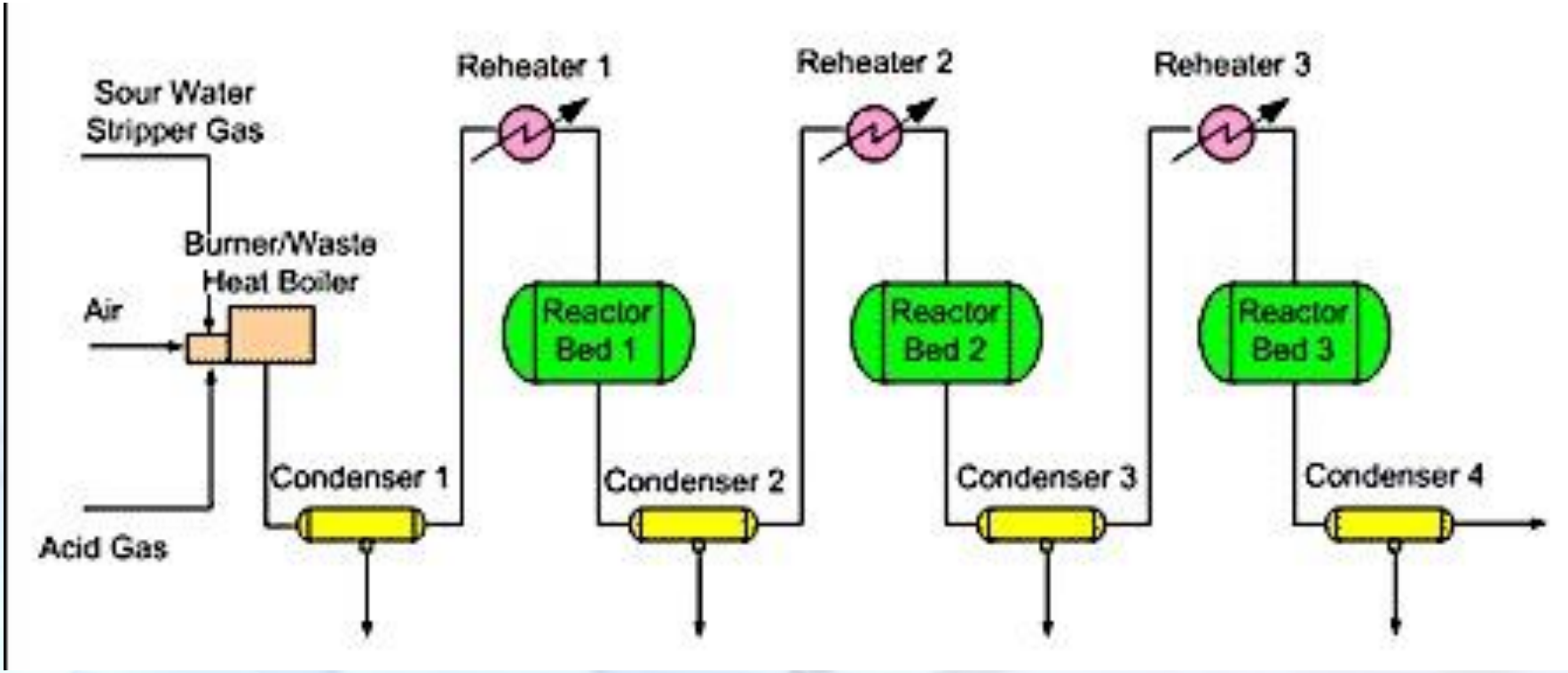
- Many gas processors in western Canada are facing low and diminishing H_2S content



- Dual challenge, must address both:
  - Reducing acid gas quality (less H_2S)
  - Stricter emissions requirements

How do we maintain sulfur recovery?

Sulfur Recovery Unit (SRU)



2-step reaction:

$$3H_2S + \frac{3}{2}O_2 \rightarrow SO_2 + 2H_2S + 3H_2O$$

$$2H_2S + SO_2 \rightarrow S + 3H_2O$$

Main Issues

- **Operating Sulfur Recovery Unit (SRU) is more difficult with less H_2S**

- **Less H_2S means less fuel and more CO_2 – 'double blow' to reaction furnace**

- **More CO_2 also means more COS formation -> increased loss**

Issues (cont'd)

Equipment becomes over-sized as sulfur production decreases:

- Initial design based on specific H_2S feed content
- Valves operate well only within ~30 to 80% opening.
- Partial pressures decline in catalytic beds
- Control system requires assessment / upgrade

The Reaction Furnace: Heart of the Claus Unit

- Key issue: How to keep the furnace flame stable with lower H_2S content

- Very difficult to maintain a stable flame with less than 20% H_2S

Case Study 1: Gas processor in NW Canada

- Worried about reduction from 50% to 20% H_2S , how to operate, meet regulations?
- Thought split-flow but too much methanol in feed gas!

RECOMMENDED:

- Thought of co-firing retrofit with natural gas
- Or oxygen enrichment >28%
- Both promote BTEX and Methanol destruction

Case Study 2: Gas Processing Plant in NW Canada

- **~3% H_2S content in acid gas- and declining**
- **Currently utilize a Sulfur Recycle system**

- **Recent tasks completed**
  - Combustion control system upgrade (essential for fluctuating and diminishing acid gas) (maintain H_2S:SO_2 ratio)
  - Furnace upgrades to adopt to lower H_2S concentration

Reaction Furnace Solutions

Configuration	Good Between 30-40% H_2S	Good Between 10-30% H_2S	Good Below 10% H_2S	Continuous Operating Cost	Promotes contaminant destruction
Fuel Gas Co-Fire	✓	✓	✓	✓	✓
Oxygen Enrichment	✓	✓		✓	✓
Acid Gas Preheat (>200 °C)	✓			✓	✓
Split-Flow	✓	✓			
SelectOx		✓	✓		
Sulfur Recycle			✓		

Many Factors to Consider…

- Your province or state's regulations / allowable SO_2 emissions
- Required sulfur recovery efficiency
- Presence of Contaminants (BTEX, NH_3, Methanol etc.)
- Ease of installation of additional equipment
- Additional (continuous) operating costs of Fuel Gas, oxygen etc.

Fuel Gas Co-Firing: In-Detail

- **Pros**
  - Easily achieve operating temperature of 1200+ deg C
  - Versatile for varied H_2S content (as low as 4% H_2S seen)
  - Most popular retrofit

- **Cons**
  - Increases flow rate through unit <-> residence time decreases
  - CS_2 production increases
  - Producing greenhouse gas -> CO_2
  - Burning natural gas product

Oxygen Enrichment: In Detail

- **Pros**
  - No added hydrocarbons (and resulting CS_2 formation)
  - Increases unit's capacity
- **Cons**
  - Expensive – continuous operating cost
  - Requires additional equipment to unit
  - Can increase SO_2 emissions

SRE Services

- **Performance evaluation**
  - Determine baseline performance at stable operation
  - Pinpoint opportunities for optimization

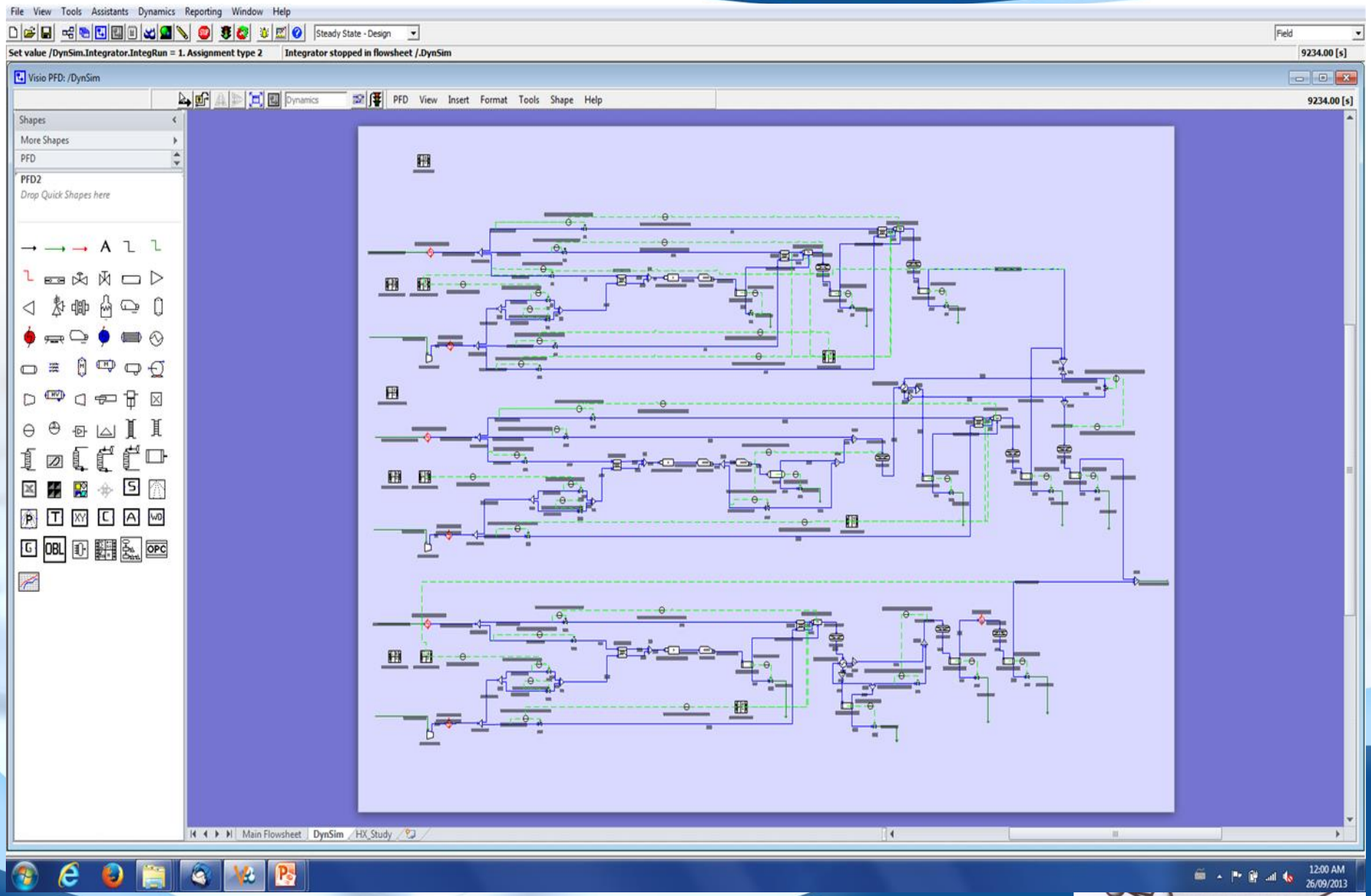
- **Capacity evaluation**
  - Evaluate individual process units
  - Determine bottlenecks through capacity evaluation

- **Steady State and Dynamic Modeling using VMG Sim®**

VMG Simulation®

DYNAMIC MODELLING

- Models hydraulics hydraulics of the process
- Evaluation of proposed modifications
- Control evaluation
- Training tool
- Monitoring tool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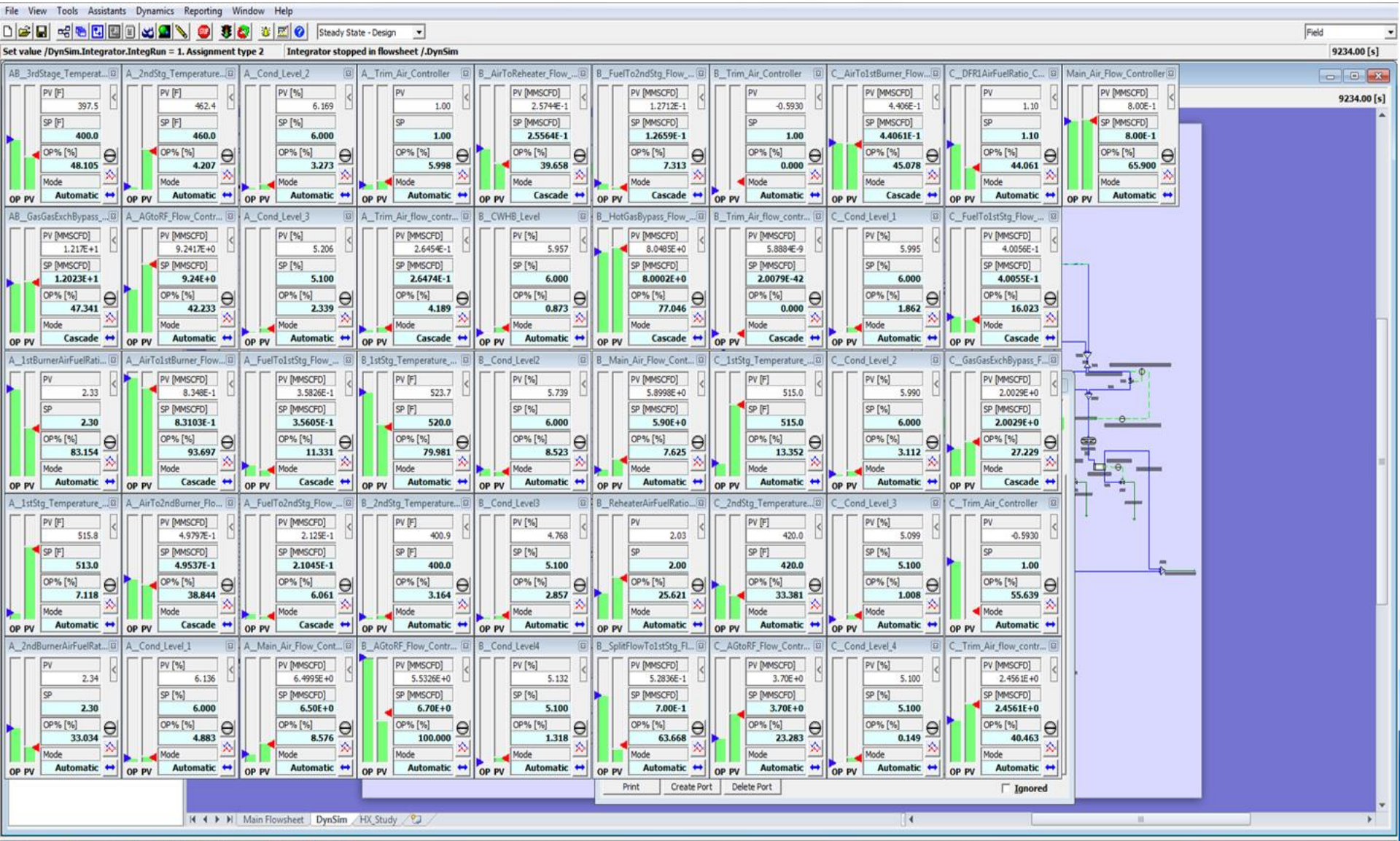
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B_FuelTo2ndStg_Flow_...
B_Trim_Air_Controller
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Conclusions

- Very common problem in NW Canada
- Many solutions available
- “One size doesn’t fit all”

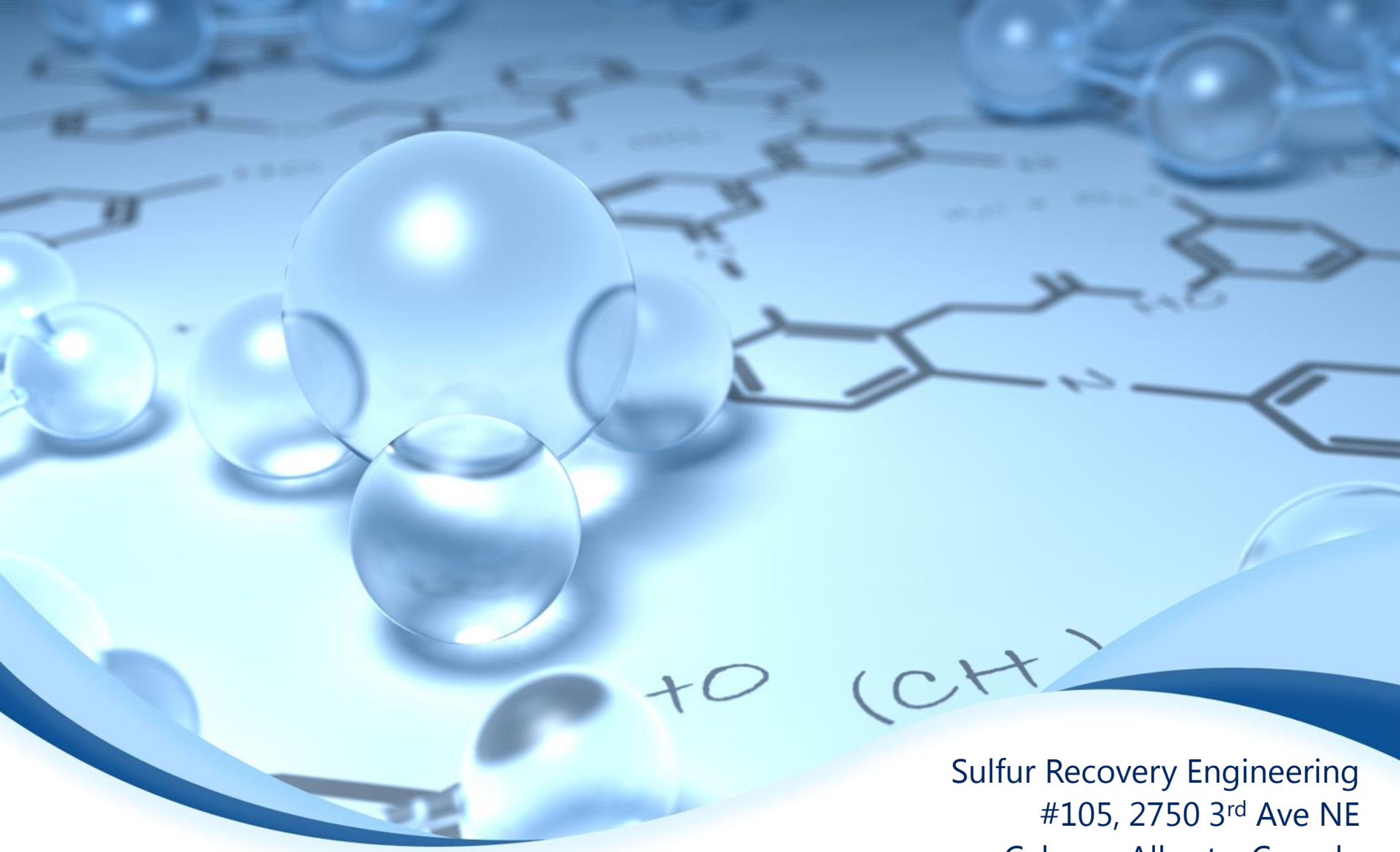
Any questions, please visit us.

Enjoy the conference!

References:

· Sulfur Plant Configurations for Weird Acid Gases (K. LaRue et. al. 2013 Laurance Reed Gas Conference 2013)

• Sulfur Recovery Engineering Advanced Seminar



Thank You!

Sulfur Recovery Engineering
#105, 2750 3rd Ave NE
Calgary, Alberta, Canada
T2A-2L5
www.sulfurrecovery.com
(403) 226-5951