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ENERGY: OIL & GAS

Seeq

Sjoerd Hoogwater

Phillips 66

conneqt

Coke Drum Blowout Identification

Ryan DeFever

Engineer, ERI

Phillips 66

Cliff Amundsen

Modeling Engineer, ERI

Phillips 66

Sjoerd Hoogwater

Consulting Process Engineer

Phillips 66 Midstream

Leading Integrated Downstream Energy Provider

- Positioned for value creation through economic cycles

CHEMICALS

Chemicals and polymers the world needs

- 95% advantaged feedstock portfolio.
- Proprietary technology and global marketing network.

MARKETING & SPECIALTIES

Phillips 66®, Conoco®, 76®, JET® and Coop branded fuels and services

- ~7,260 sites in the U.S. and ~1,670 internationally.
- Leading lubricants manufacturer in the United States.

MIDSTREAM

Highly integrated with other segments

- Natural gas liquids wellhead-to-market value chain.
- Crude oil and product pipelines and terminals.
- 70,000+ miles of crude oil, refined petroleum product, NGL and natural gas pipeline systems in the United States.

REFINING

Geographically diversified and vertically integrated

- 9 refineries in the United States.
- 2 refineries in Europe.
- 1.8 million BPD of crude capacity.

RENEWABLE FUELS

World-scale producer in renewable fuels

- Rodeo Renewable Energy Complex.
- Renewable feedstock processing of ~50,000 BPD (~800 million gallons per year).
- Capability to produce ~10,000 BPD of renewable jet (blend up to 20,000 BPD SAF).

- As of September 30, 2024
  BPD: Barrels Per Day
  SAF: Sustainable Aviation Fuel
- On October 14, 2024, Phillips 66 announced the agreement to sell interest in Switzerland-based joint venture with COOP in the first quarter of 2025.
- On October 16, 2024, Phillips 66 announced plans to cease operations at the Los Angeles Refinery in the fourth quarter of 2025.

Integrated Downstream Energy Company

Enabling long-term value creation and positioning for the future

MISSION

Providing Energy. Improving Lives.

VISION

Be the leading integrated downstream energy provider.

VALUES

Safety. Honor. Commitment.

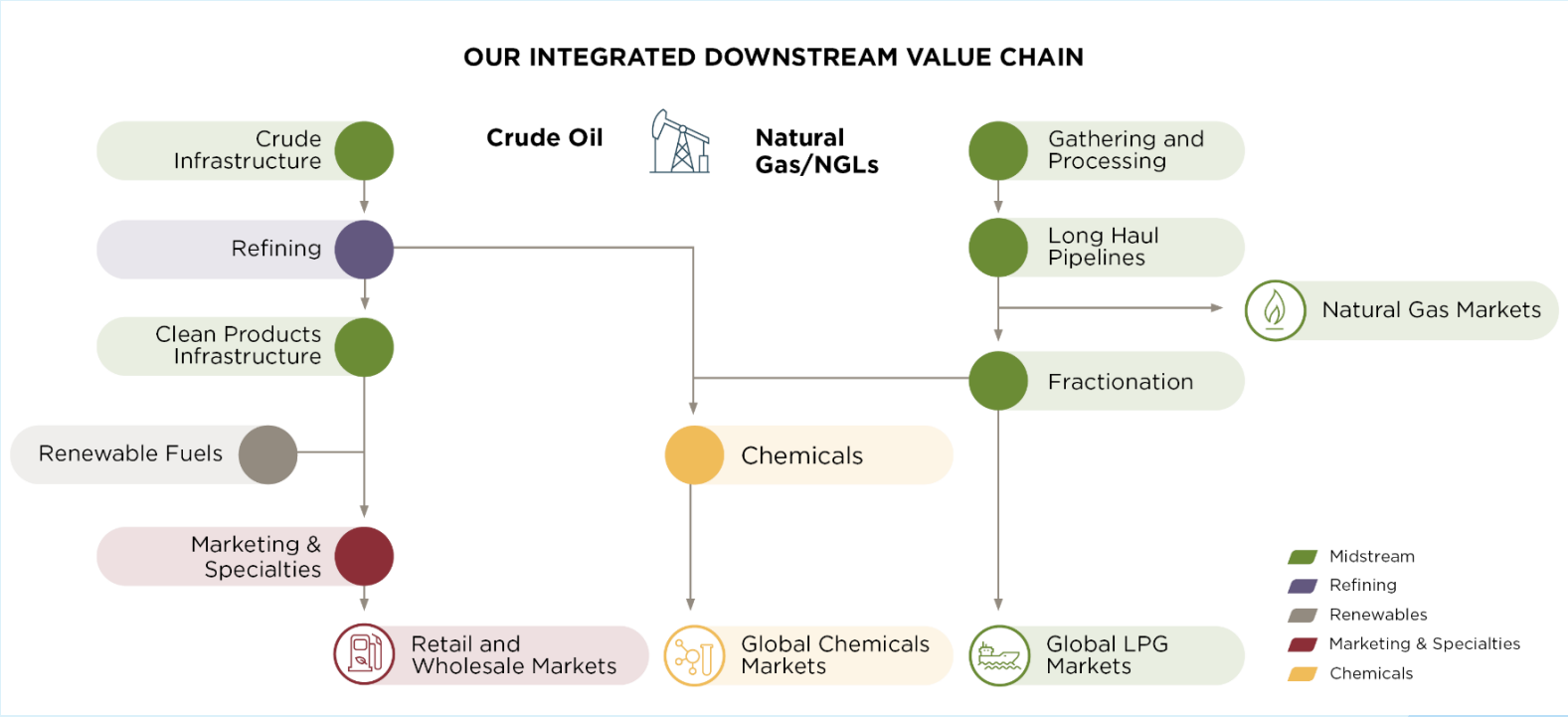
OUR ENERGY IN ACTION

Work for the greater good.

Cultivate an environment of trust.

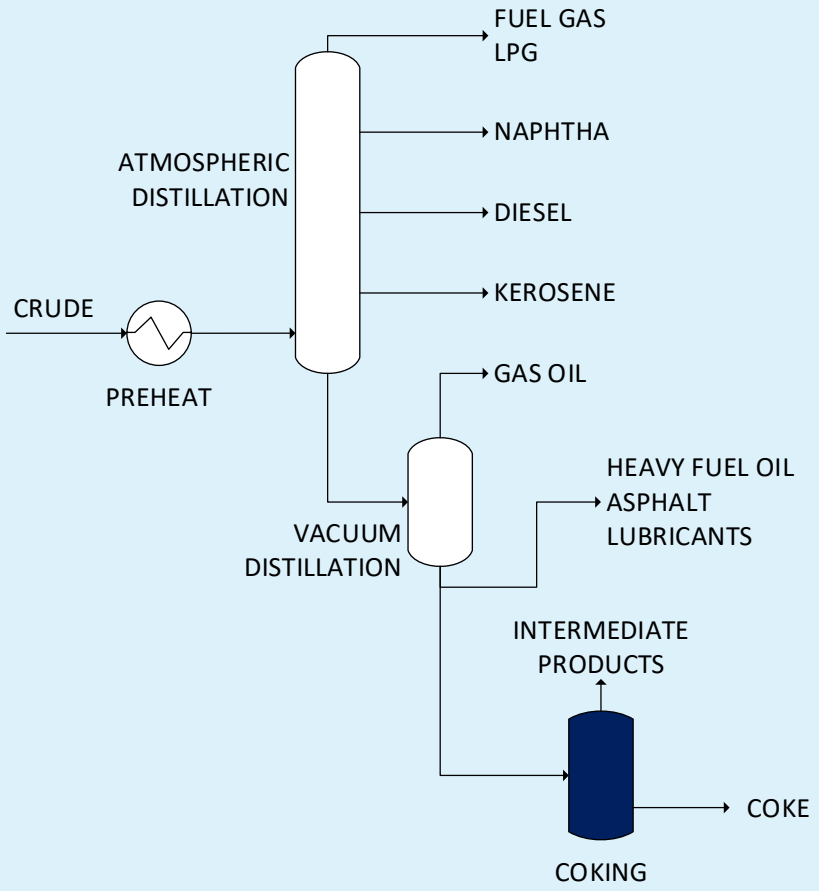
Seek different perspectives.

Pursue excellence.



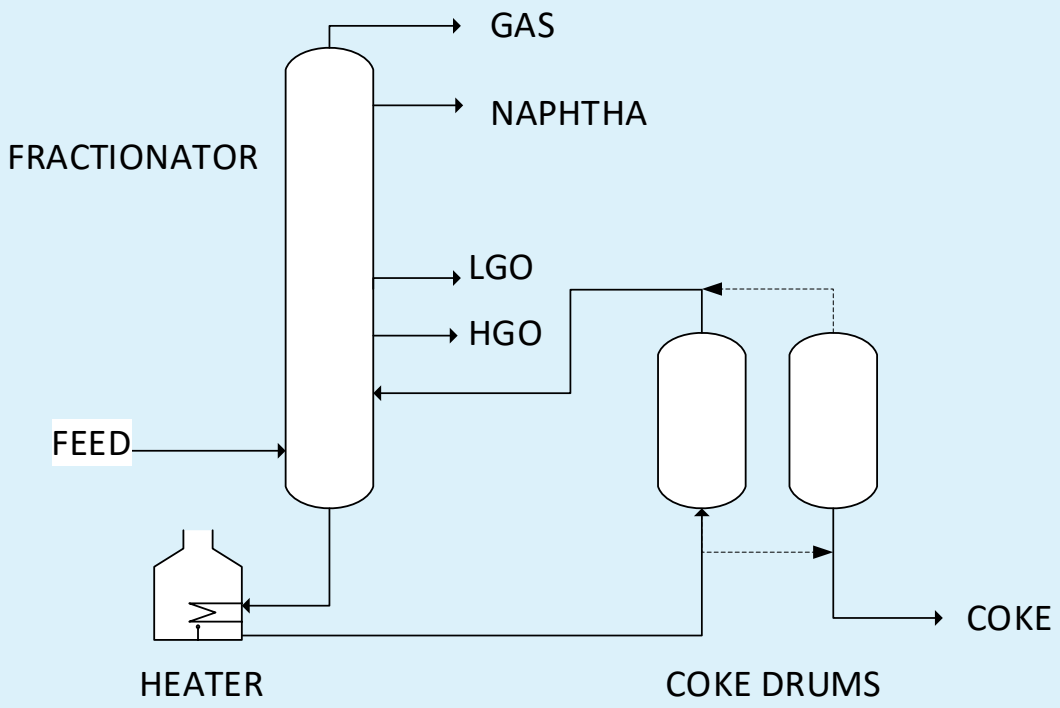
What is a coker?

- Processes heavy residue to produce distillates (naphtha, diesel)
- Coke is mostly carbon
- Used for fuel, electrodes, steel manufacturing



Typical configuration

- Fractionator
- Heater
- Coke drum vessels
  - One in filling mode: coking reaction results in solid coke deposition (~22 hours)
  - One in decoking mode
    - Quench with steam
    - Quench with water
    - Drill out coke with automated water drills (~5 hours)



Phillips 66 Borger Refinery

Coke Drum Blowouts - background

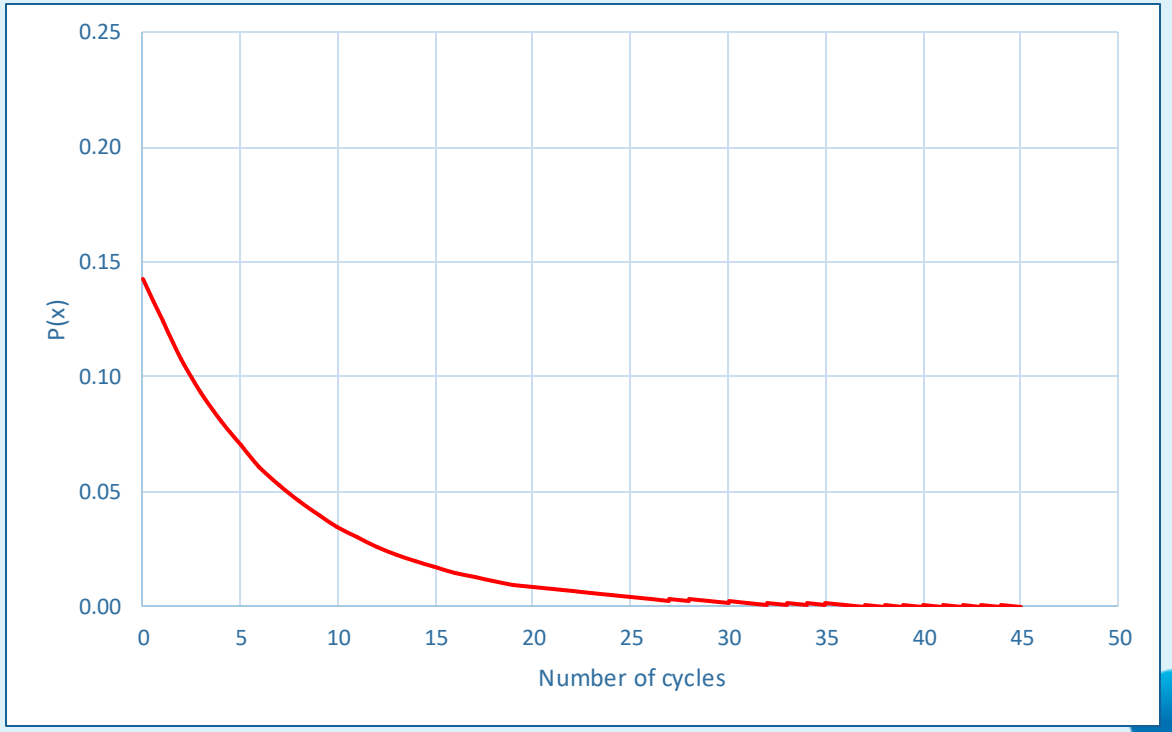
- Water from the cutting drill hits ‘hot spot’ of coke
- Blowouts are a safety issue
- Identification is the first step to determining causes/mitigating actions
  - Large blowouts are readily apparent
  - Smaller blowouts may go unnoticed → data likely improperly labeled
- Are blowouts randomly happening, or are they correlated?

Statistics – Exponential distribution

Assumptions:

- Events occur independently
- Events occur at a constant average rate

We can use Python to compare the time between blowouts with an exponential distribution, $\lambda = 1/7$



How can we identify smaller coker blowouts?

CHALLENGE

Blowouts last less than 1 minute and occur up to a few times per month

Need data at ~5 second intervals to see small blowouts

SOLUTION

Pull multiple tags from historian and perform data analysis of coker operations

RESULTS

With Seeq, we can identify blowout events and analyze them to find correlations

Coke Drum Blowout analysis without Seeq

- Pull PI data for several years (~GB) into CSV
  - 5 second intervals = 6.3 million datapoints per tag
- Use Python for analysis
- Save hundred+ page PDFs for manual validation

Coke Drum Blowout Identification in Seeq

- Capsules
  - Cutting stage – from tag value seach
  - Cutting drill active – from tag value search
  - Drum pressure spike – positive derivative of smoothed pressure measurement
- Possible blowout when all capsules intersect

Coke Drum Blowout Identification in Seeq

10 day trends

Coke Drum Blowout Identification in Seeq

20 minutes

Coke Drum Blowout: Statistical Analysis

Pull data into Seeq DataLab

[4]:

```
results = spy.search({
    'Path': 'AGCokeBlowout',
    'Asset':  'Refinery Drum *',
    'Name': 'Blowout',
    'Scoped To': WORKBOOK_ID
}, old_asset_format=False)
blowout_ids = results[results['Name'] == 'Blowout']
large_blowout_ids = results[results['Name'] == 'Large Blowout']
```

Query successful

	Path	Asset	Name	Scoped To	Time	Count	Pages	Result
0	AGCokeBlowout		Blowout	0EF825E5-27C2-E8A0-B15B-7D49F30996C9	00:00:00.11	4	4	Success

Coke Drum Blowout: Statistical Analysis

Use Python packages for statistical analysis

[142]:

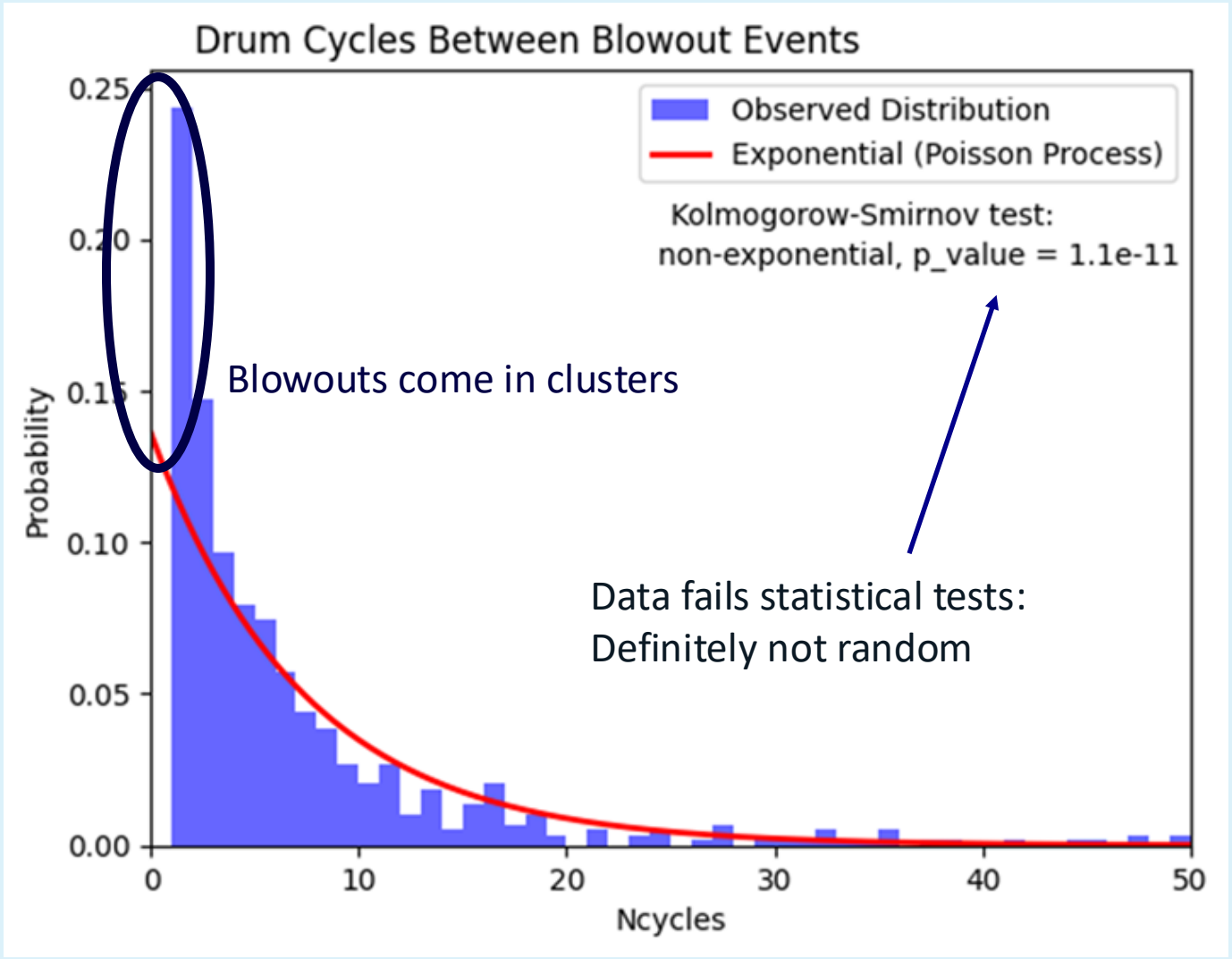
```
observed_data = df_cut['delta_n_cuts'].values.astype(int)
lambda_est = 1 / observed_data.mean()

# Step 2: Perform a goodness-of-fit test (Kolmogorov-Smirnov test for exponential distribution)
ks_stat, p_value = stats.kstest(observed_data, 'expon', args=(0, 1/lambda_est))

print(f"KS statistic: {ks_stat}, p-value: {p_value}")

```

Coke Drum Blowout: Statistical Analysis



Coke Drum Blowout Identification in Seeq

- No need to pull PI data using Excel or custom Python connectors
- Easy visualization and troubleshooting
- Fast iteration: analysis took < 2 hours to build

Coke Drum Blowout Identification in Seeq

- Leverage Solution
  - Extend to other coke drums with asset groups
  - Easy to share analysis with other engineers
- Machine Learning
  - Pull blowout events into Python for further analysis
- Identifying and analyzing blowout events helps us to improve our operations and work safely
- Still evaluating mitigation options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Questions?


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Thank You