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CATEGORY ABBREVIATION: R&D and gas processing enhancement
SESSION NUMBER: 29
ABSTRACT NUMBER
PRESENTATION TITLE: Liquids, Hydrates and Foam Detection Improves Operational Excellence in Gas Treatment

Liquids, Hydrates and Foam Detection Improves Operational Excellence in Gas Treatment

“Use innovation to drive operational excellence”

“We can’t keep doing things the way we are doing them”

Natural Gas Journey

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The costs of process failures are high:

- extra labour
- consumables
- replacement parts
- loss of production

Process upsets often run into $millions

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Natural Gas Journey

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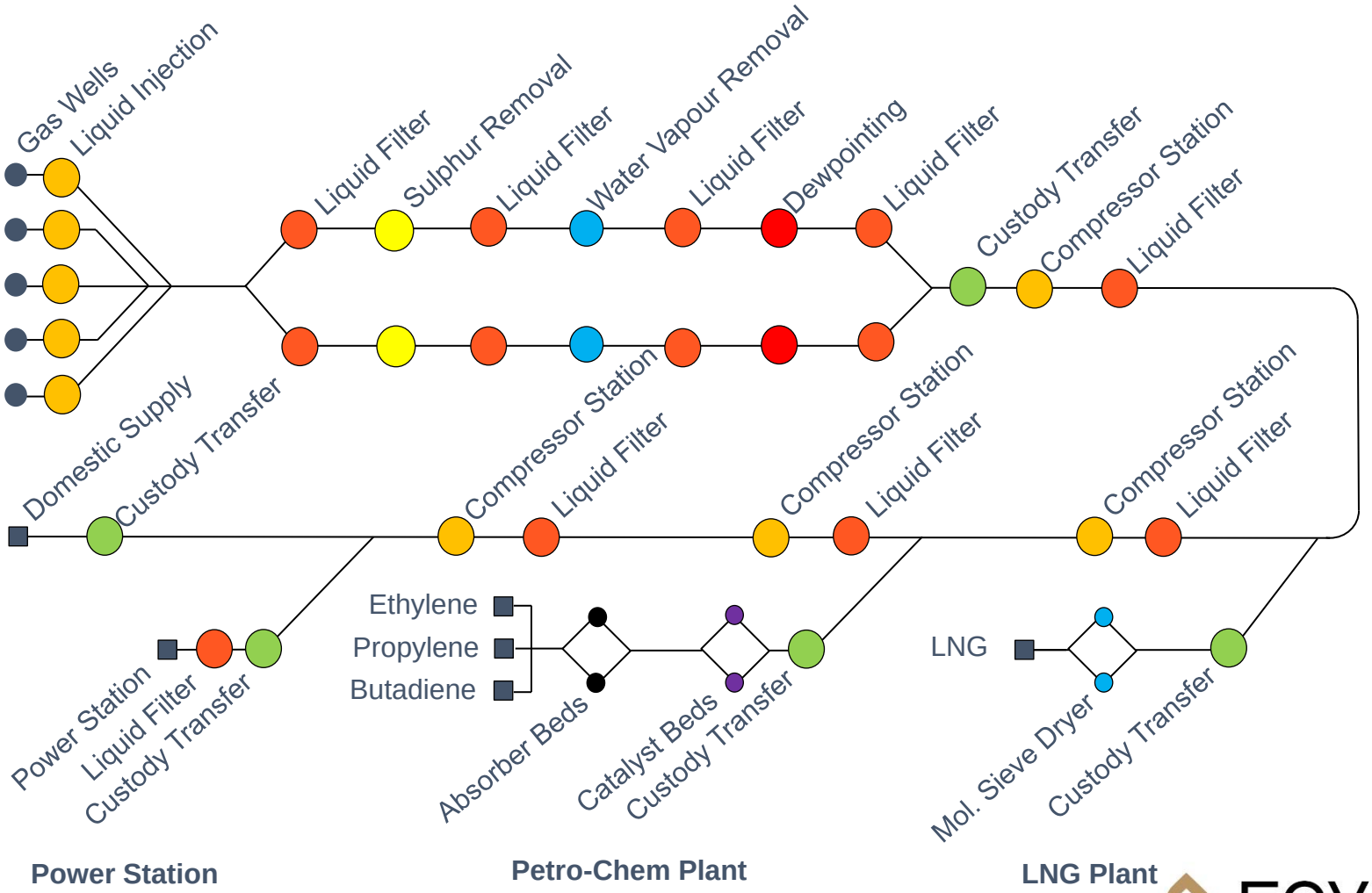

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Gas Quality

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Quality of sales gas is specified in both commercial contracts and safety management regulations:

Content or Characteristic	Value
Hydrogen sulphide (H_2S)	≤5 mg/m^3
Total sulphur content (including H_2S)	≤50 mg/m^3
Hydrogen content	≤0.1% (molar)
Oxygen content	≤0.2% (molar)
Wobbe number (WN)	(i) ≤51.41 MJ/m^3, and (ii) ≥47.20 MJ/m^3
Incomplete combustion factor (ICF)	≤0.48
Sooting index (SI)	≤0.60
Hydrocarbon dew point and water dew point	"shall be at such levels that they do not interfere with the integrity or operation of pipes or any gas appliance"

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Gas Quality

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Content or Characteristic	Value
Impurities	shall not contain solid or liquid material which may interfere with the integrity or operation of pipes or any gas appliance which a consumer could reasonably be expected to operate

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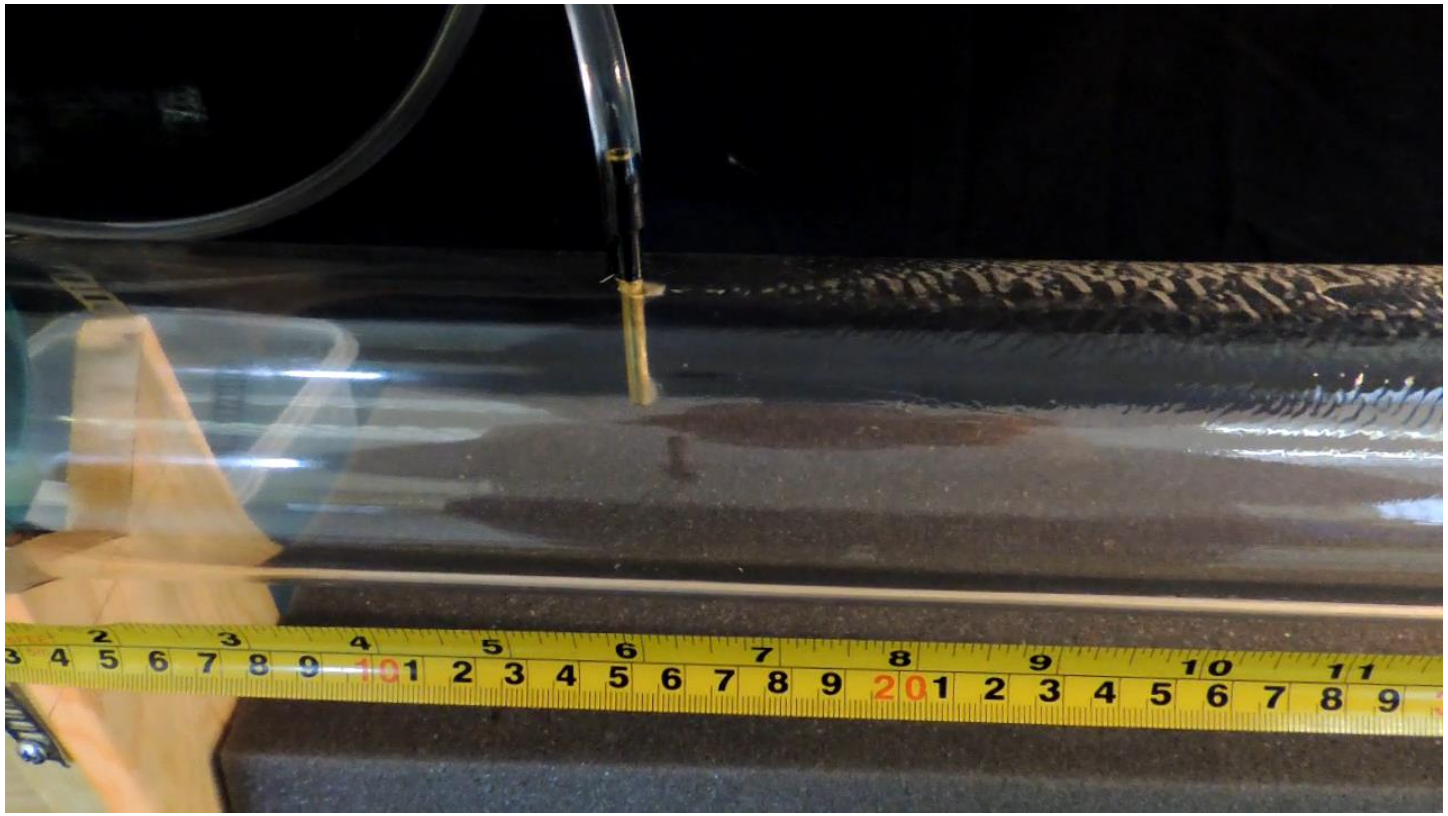

Current Analysis Methods

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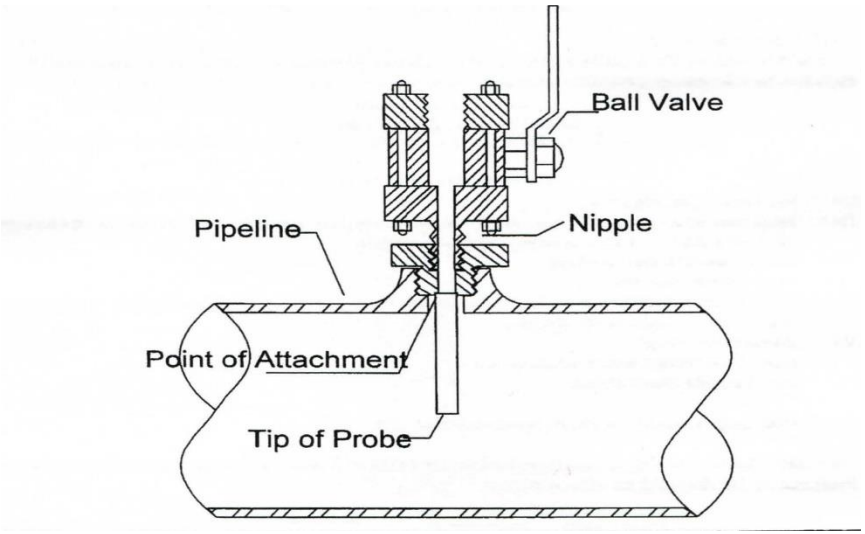
Most sampling standards recommend that insertion probe length should be within the middle 1/3 of the diameter of the pipeline. This ensures that sample does not liquids on the pipe wall.



GPA Standard 2166-05 Obtaining Natural Gas Samples for Analysis by Gas Chromatography.

Sample probes intentionally avoid any liquids on the pipe wall
Processing liquids (amines & glycols), & compressor oil are not detected with present methods.

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Current Analysis Methods

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- Dew point meters will indicate how close a gas is to its saturation point (water or hydrocarbon) but, once saturated, the dew point and the temperature are the same.
- There is no indication of how much liquid there is in the pipe once the saturation point is reached.
- **It's like trying to measure the height of water in a glass by monitoring the humidity above it.**

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Gas Treatment Plant Survey 2015

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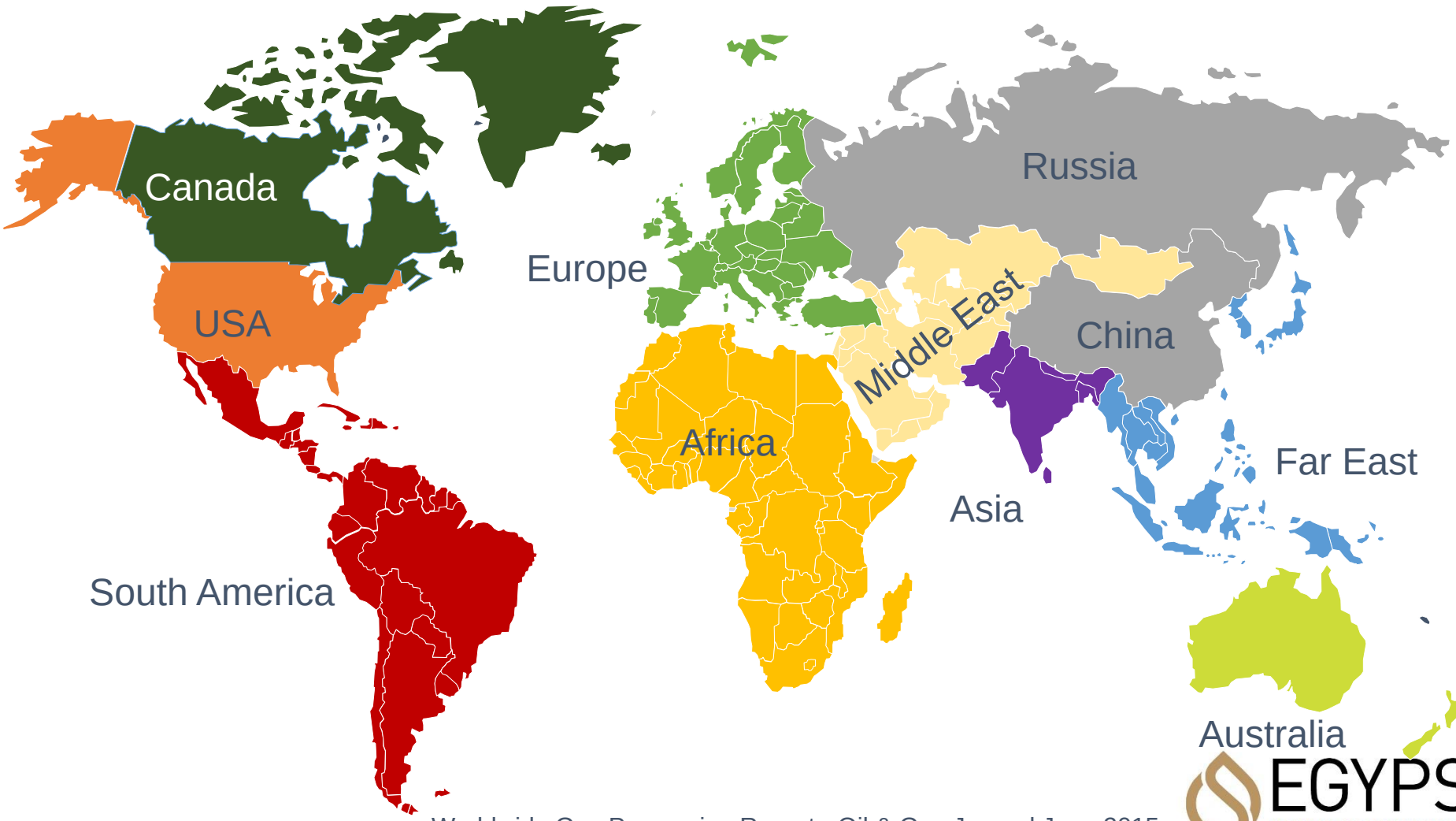

Worldwide Gas Processing Report - Oil & Gas Journal June 2015

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Number of Gas Treatment Plants

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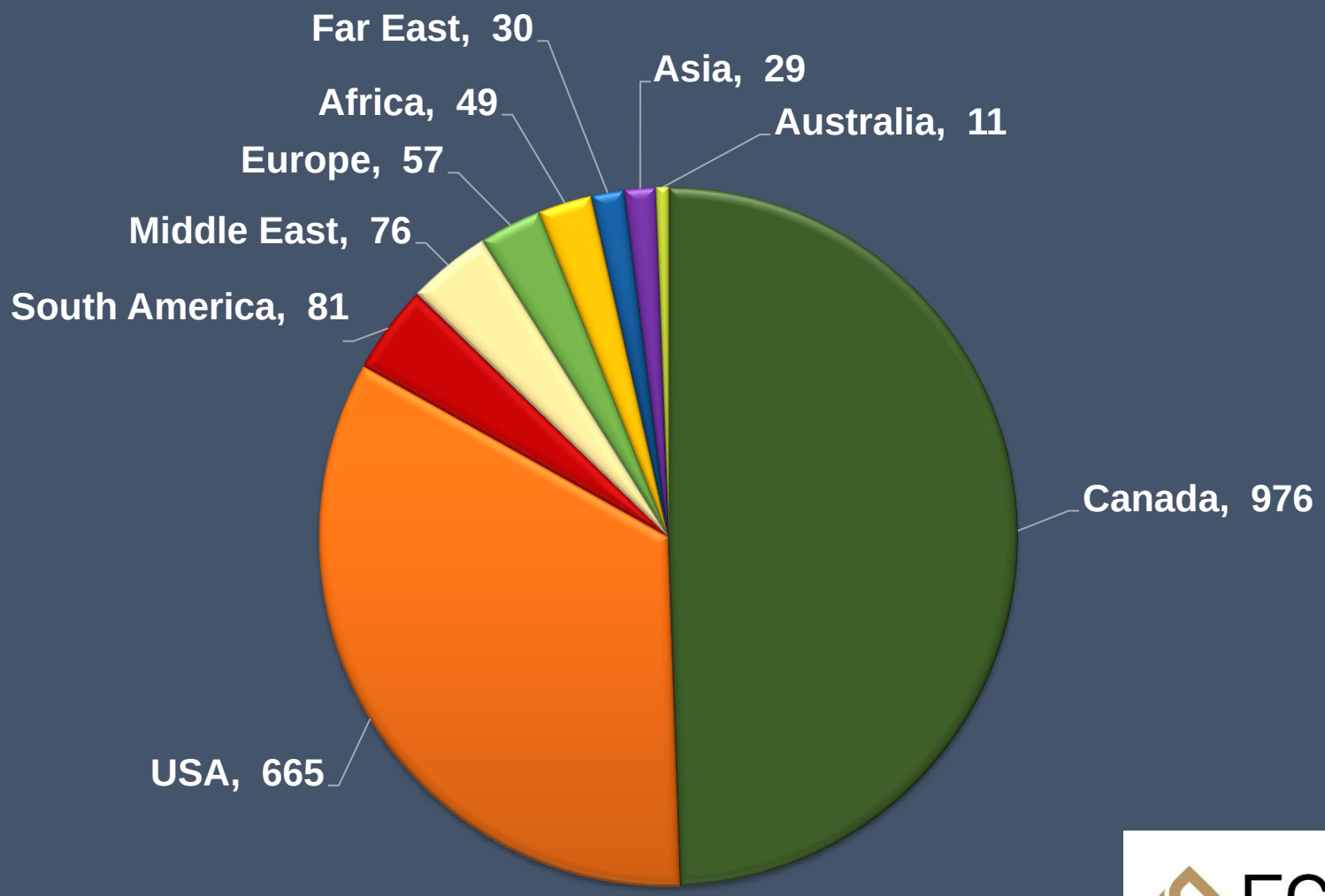

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Gas Treatment Plant Survey 2015

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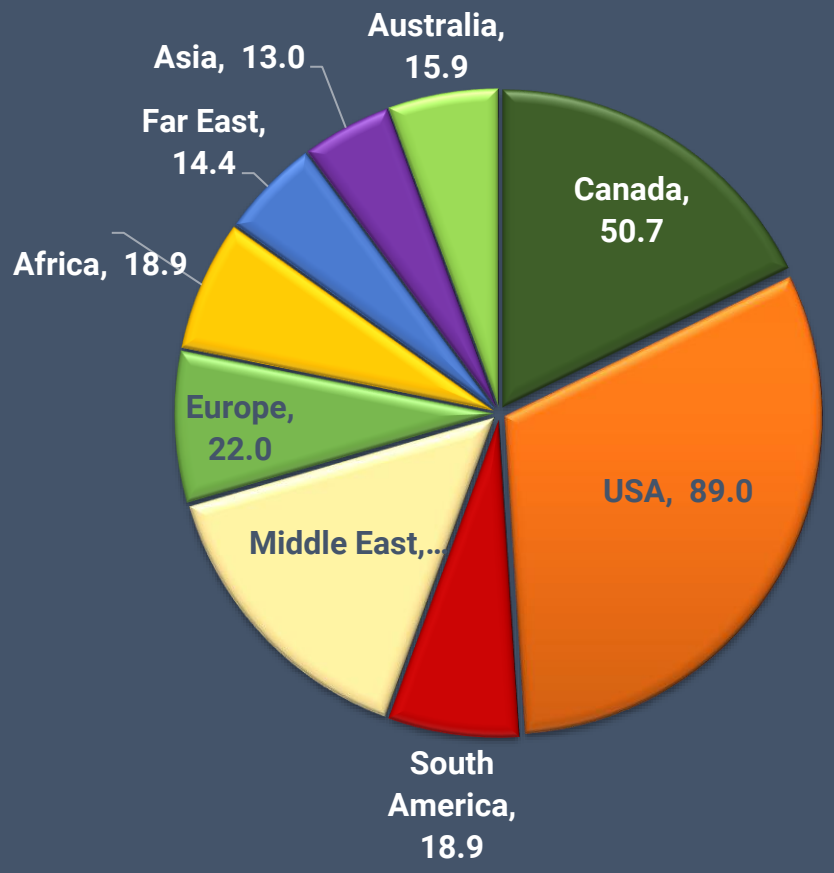
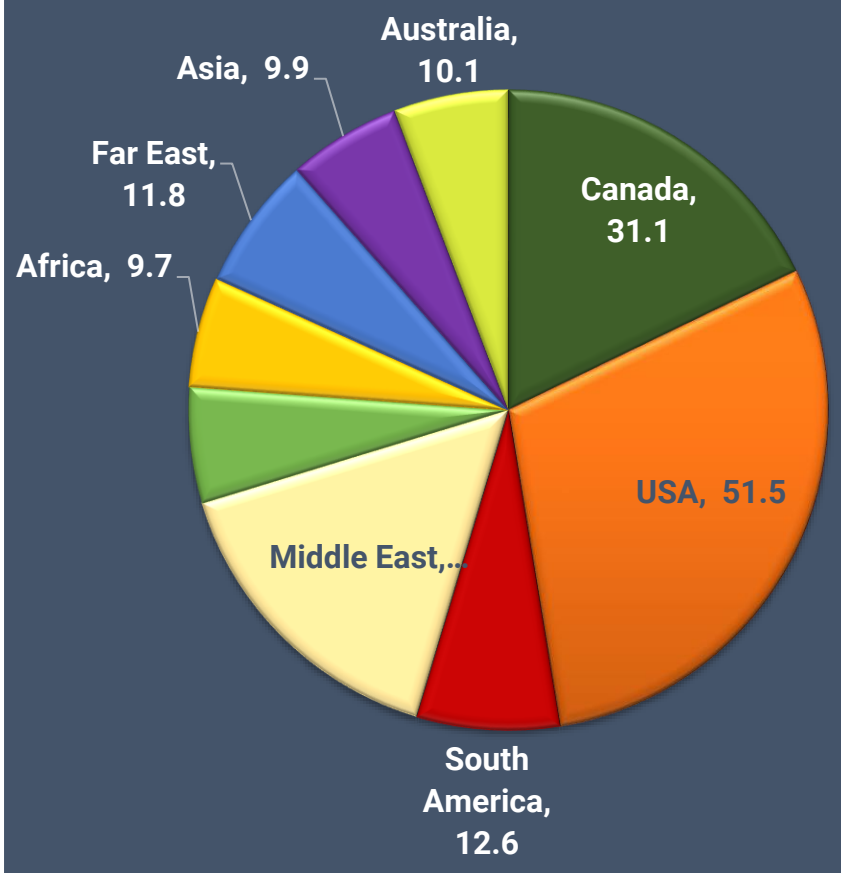


Capacity BNscf/D



Production BNscf/D

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Production Losses

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	Capacity BNscf/D	Production BNscf/D	Capacity overhead BNscf/D	Production as % of capacity
Canada	50.7	31.1	19.6	61%
USA	89.0	51.5	37.5	**58%**
South America	18.9	12.6	6.3	67%
Middle East	42.5	27.3	15.2	64%
Europe	22.0	10.2	11.7	**47%**
Africa	18.9	9.7	9.2	**51%**
Far East	14.4	11.8	2.6	82%
Asia	13.0	9.9	3.1	76%
Australia	15.9	10.1	5.8	63%
Total	**331.9**	**209.6**	**106.5**	**61%**

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Production Losses

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Gas Plants		
Failure	**Frequency**	**%**
Foaming	46	31.1%
Product quality	42	28.4%
Corrosion	37	25.0%
Flooding	12	8.1%
Amine loss	11	7.4%
Total	**148**	**100%**

92% of failures in amine plants are due to liquid carry-over

Why Amine Systems Fail – Amine Experts

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Production Losses

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- Numerous papers from the GPA GCC Conference in 2018 reported foaming as a major problem.
- One Saudi Aramco site reported around 15 foaming events per month with an average loss of production of **20%** prior to plant improvements.
- The **20%** loss of production figure is reflected in data from Nexo Solutions in the USA, citing foaming as the major cause of loss of production.

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Average Production MMscf/Day

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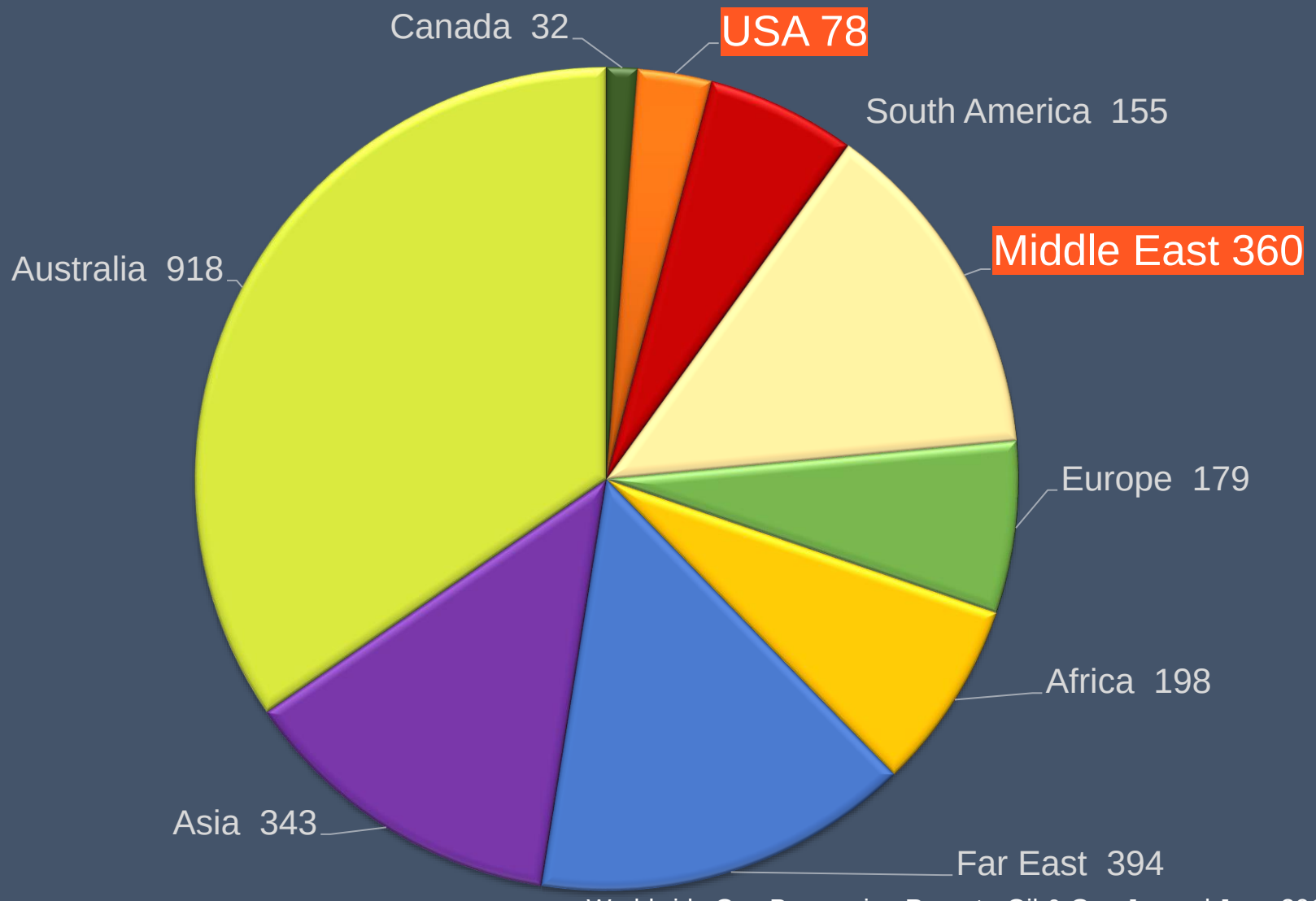

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Losses from Liquid Carry-over

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Average Sized Gas Treatment Plant in the USA		
Average production per plant in USA	78	MMscf/D
The average loss of production due to liquid carry-over **5%**	3.88	MMscf/D
Gas prices	$ 3.28	MMBTU (Henry Hub)
	$ 3.40	Mscf
Loss in production	$ 13,161	**per day**
	$ 92,129	**per week**
	$ 400,324	**per month**
	$4,803,886	**per year**

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Losses from Liquid Carry-over

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Average Size Gas Treatment Plant in the Middle East		
Average production per plant in the Middle East	360	MMscf/D
The average loss of production due to liquid carry-over **5%**	17.98	MMscf/D
Gas prices	$ 3.28	MMBTU (Henry Hub)
	$ 3.40	Mscf
Loss in production	**$61,064**	**per day**
	$427,446	**per week**
	$ 1,857,354	**per month**
	$22,288,252	**per year**

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What's Normal?

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What should we expect from a gas separator system?

FERC - Central Kentucky Transportation Company

shall be commercially free from particulates or other solid or liquid matter which might interfere with its merchantability or cause injury to or interference with proper operation of the lines, regulators, meters and other equipment of Transporter;

FERC - Cimarron River Pipeline, LLC

The gas shall be commercially free from objectionable odors, bacteria, solid matter, dust, gums and gum-forming constituents, free liquids, crude oil, and any other substance that might interfere with the merchantability of the gas, or cause injury to or interference with proper operation of the lines, meters, regulators, compressors, processing plants,
or appliances through which it flows.

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Nexo Solution Study

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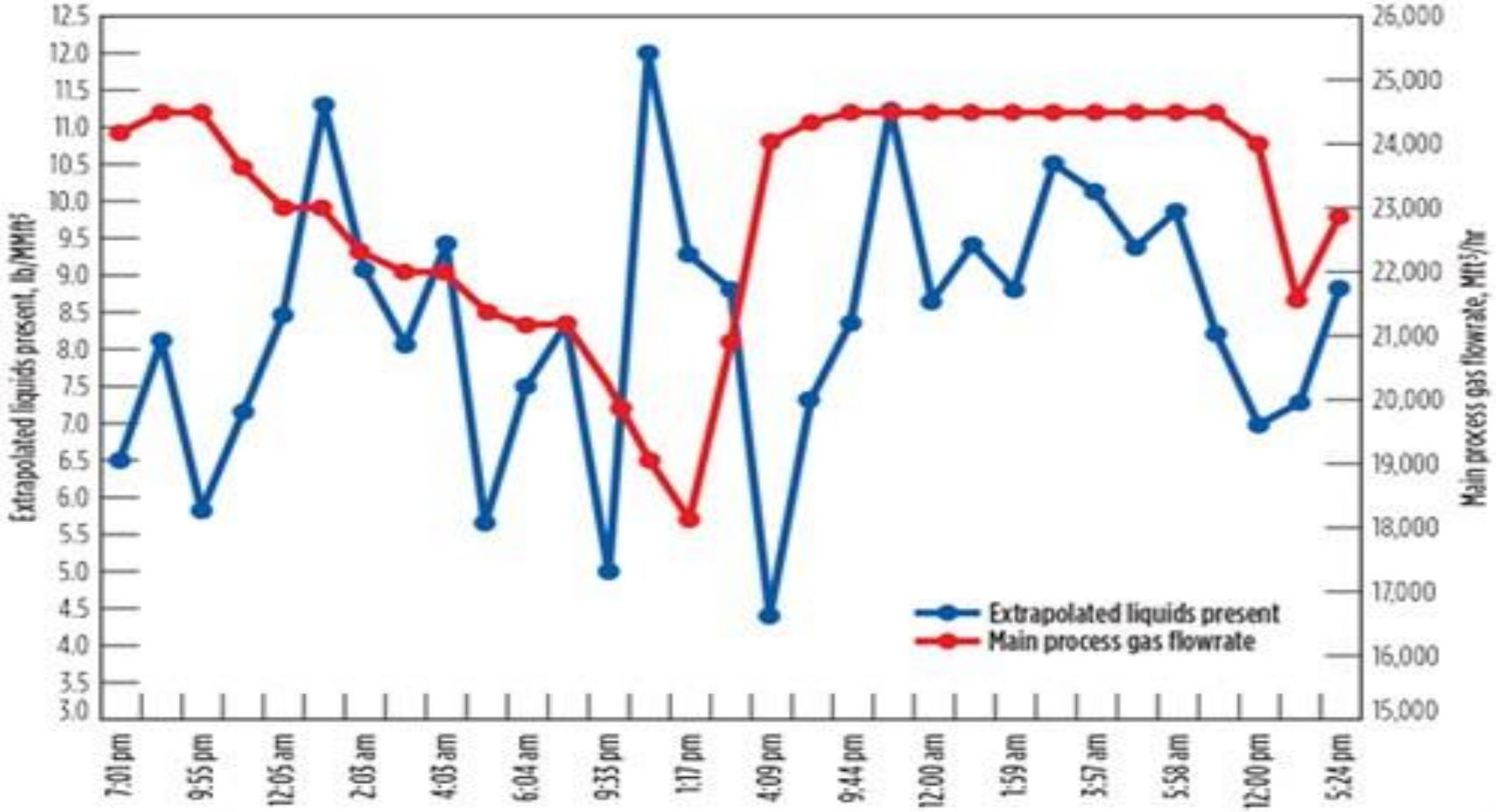

588 MSF/day at 50 Bar G (725 psi)

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Separator Specifications

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Separator specifications related to the separator in the study: 588 MSF/day at 50 Bar G (725 psi)

	Separator Spec	Equivalent US Gal/day	Equivalent Litres/day
US gal/MMscf	0.1	58.8	223
PPMw	1	10.2	38.6
US gal/MMscf	0.01	5.88	22.3
PPMw	0.01	0.10	0.39
PPMw	0.002	0.02	0.08

	lbs/MMscf	USGal/Day	Litres/day
Study result	10	981	3,714

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Custody Transfer Points

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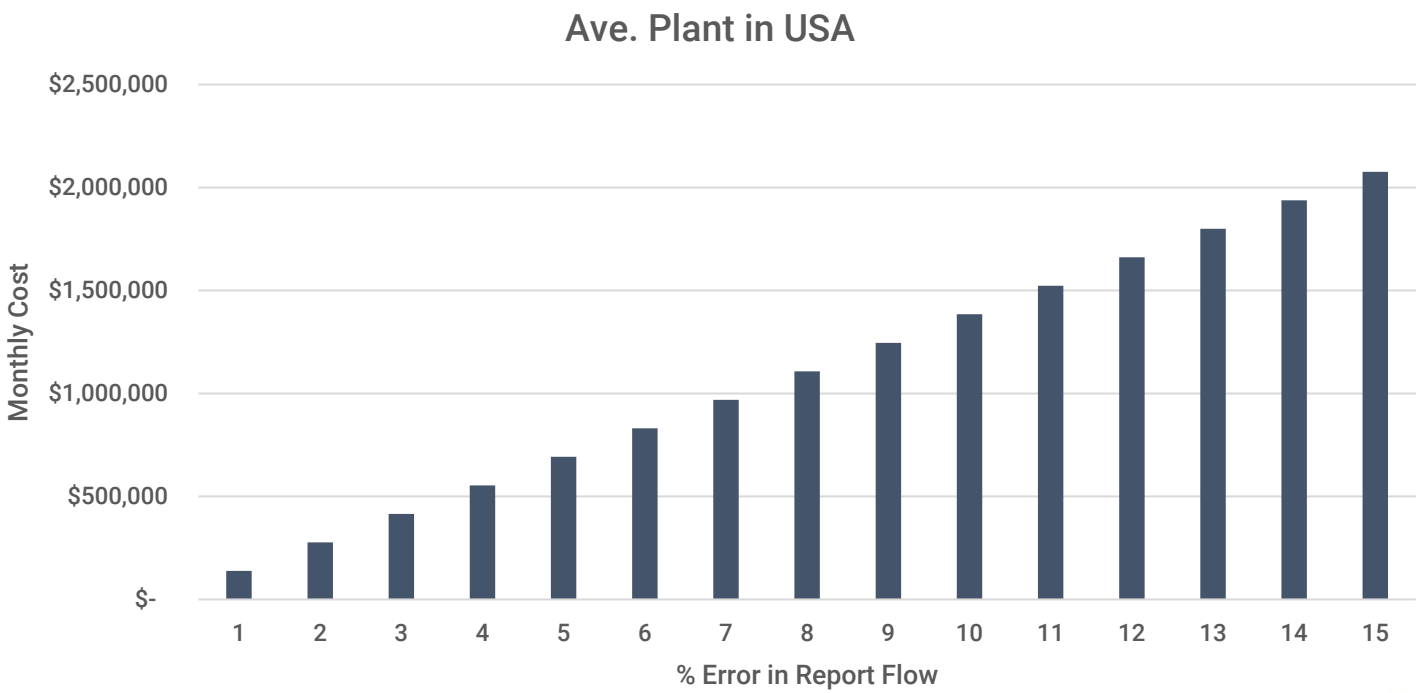
Flow metering errors on reported flow on average size plant in the USA (78MMscf/D)



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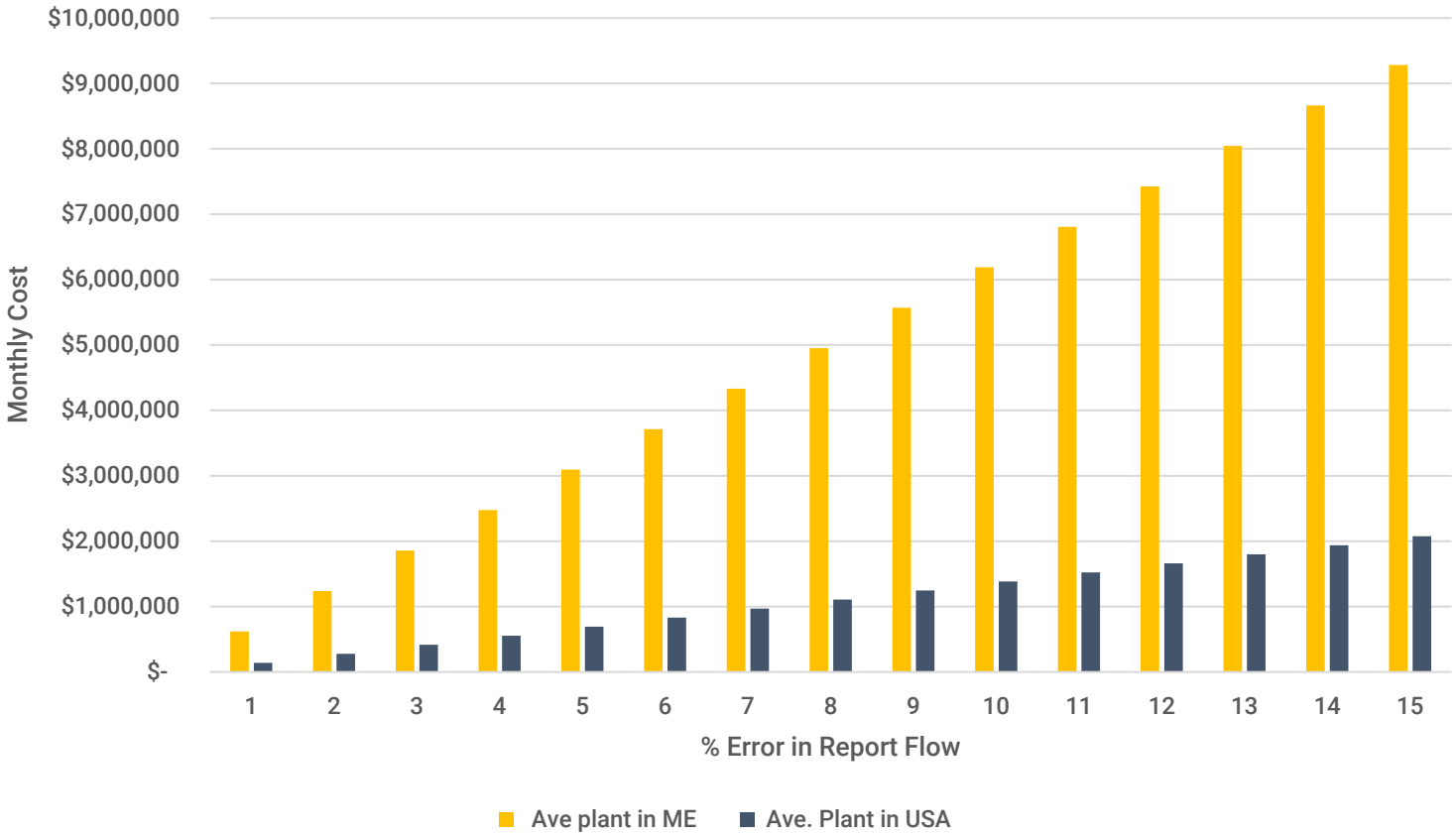
Custody Transfer Points

Process Vision



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Gas Transmission

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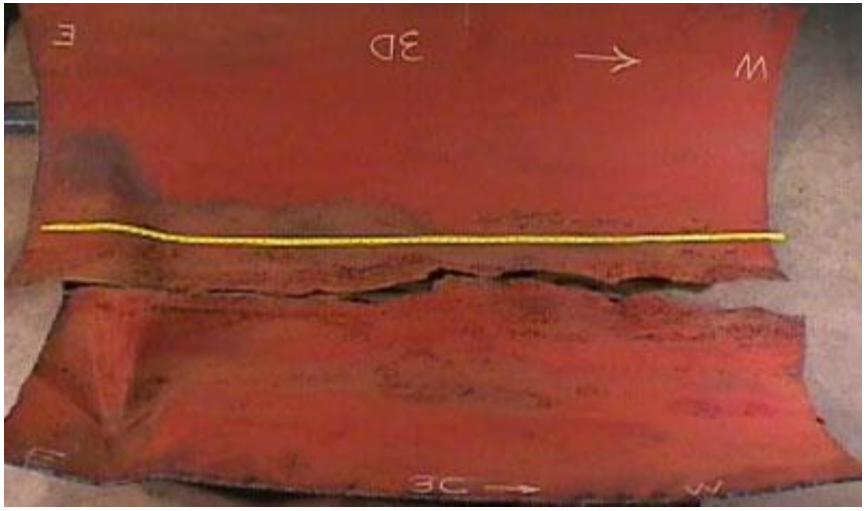
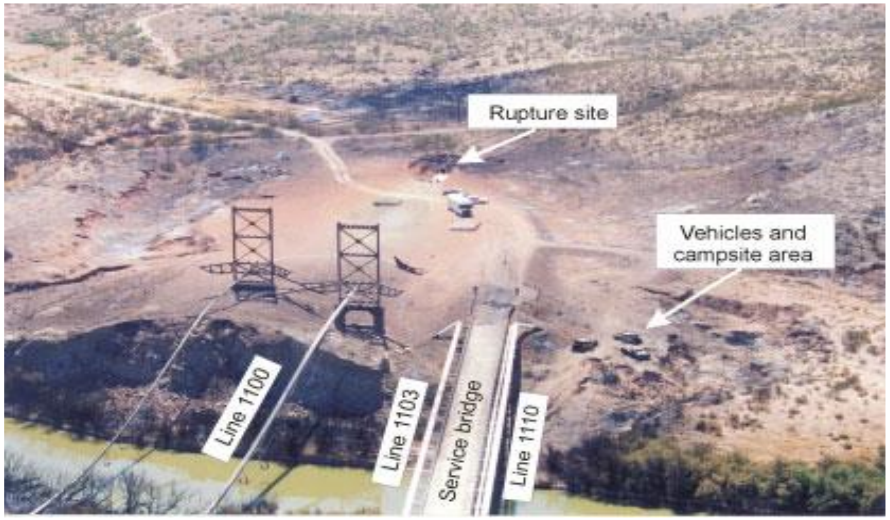
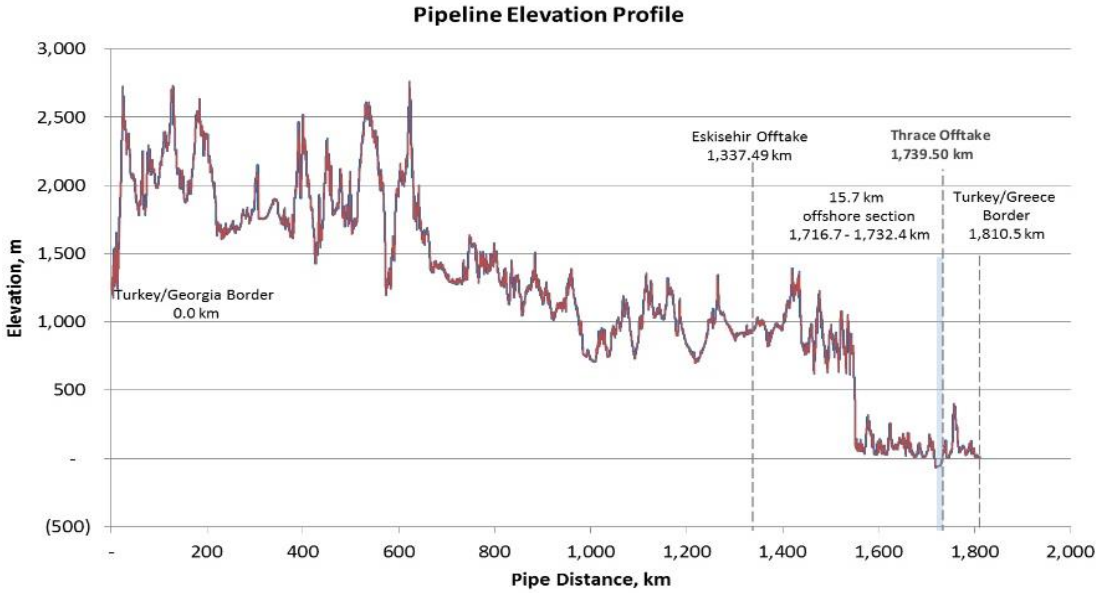




Trans-Anatoline Natural Gas Pipeline (TANAP)



Pigging

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- Normal gas velocities of 15 to 35mph (15.6 m/s)
- Usual procedure for pigging reduce to optimum cleaning speed usually around 11 mph (5 m/s).

Pipe Diameter (inches)	Normal capacity (MMscf/Day)	Capacity when pigging (11 mph)	Difference	Cost of pigging per day
8	734	269	465	$ 1,578,697
10	917	336	581	$ 1,973,372
12	1,101	404	697	$ 2,368,046
24	2,202	807	1,394	$ 4,736,092
30	2,752	1,009	1,743	$ 5,920,115
36	3,303	1,211	2,092	$ 7,104,138
40	3,670	1,346	2,324	$ 7,893,487
44	4,037	1,480	2,556	$ 8,682,835
48	4,404	1,615	2,789	$ 9,472,184
51	4,679	1,716	2,963	$10,064,195
56	5,137	1,884	3,254	$11,050,881

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A Solution - LineVu

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- A patented video system using image processing to provide an alarm
- Mounted over a pipeline
- Looks through a DBB valve to the pipe floor
- Optics are away from the flow

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LineVu

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- Secondary containment
- Illumination system heats windows to avoid condensation in wet gases

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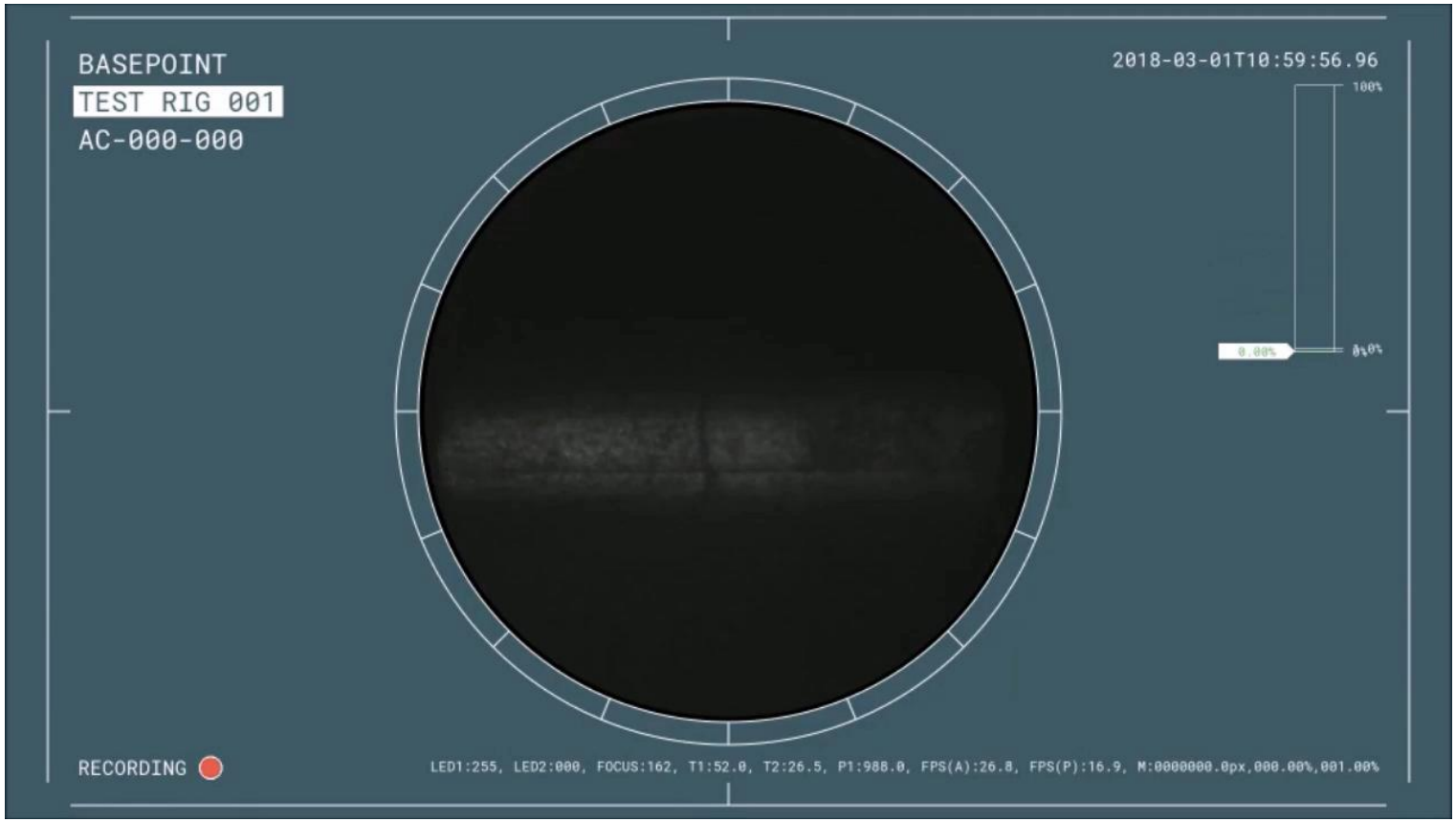

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Data is split between up to 6 cellular network providers in a bound cellular network system

Encryption & compression

If no cellular network is available, a small satellite communication can be used

Volt free alarm contacts

24V DC

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Secure server access via two-step authentication for approved users

- Via internet browser
- Email
- SMS message
- Mobile phone push notification
- Available to central technical resource
- Printed report stills for reports

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Conclusion

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- Liquid carry-over is one of the main contributors to loss of production in natural gas systems
- Permanent monitoring of liquid carryover from separator systems is now available
- A system that helps engineers understand separator problems will help treat the cause of liquid carry-over rather than treat the symptoms

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THANK YOU

Paul Stockwell
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