Webinars

Separation Technology Technical Section

Oversizing Separators – Too Much of a Good Thing?

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SPE International

SEPARATORS ARE LIKE PICKUP TRUCKS

Separators Over Time:

- Have Increased in Size
- Are Bigger & More Complex
- Still Perform The Same Basic Functions

BUT - Is Bigger Necessary?

AGENDA

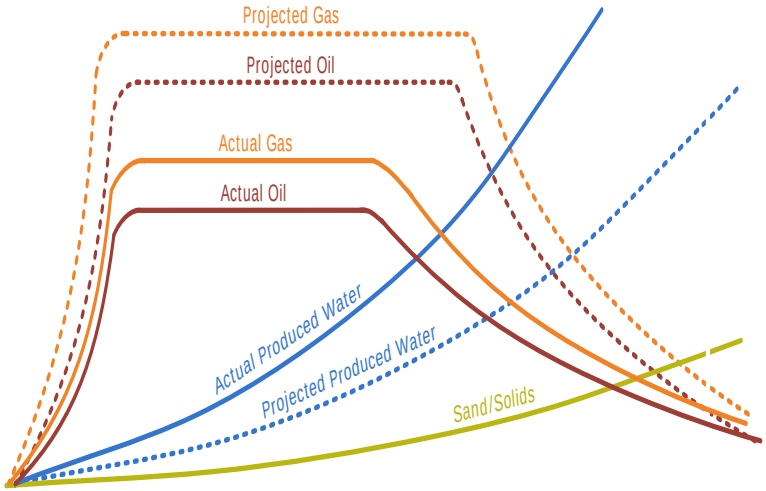
- Separation System Design Basis
- Pros/Cons of Oversizing Separators
- Elements of Separator Design
- Looking Back to Look Ahead

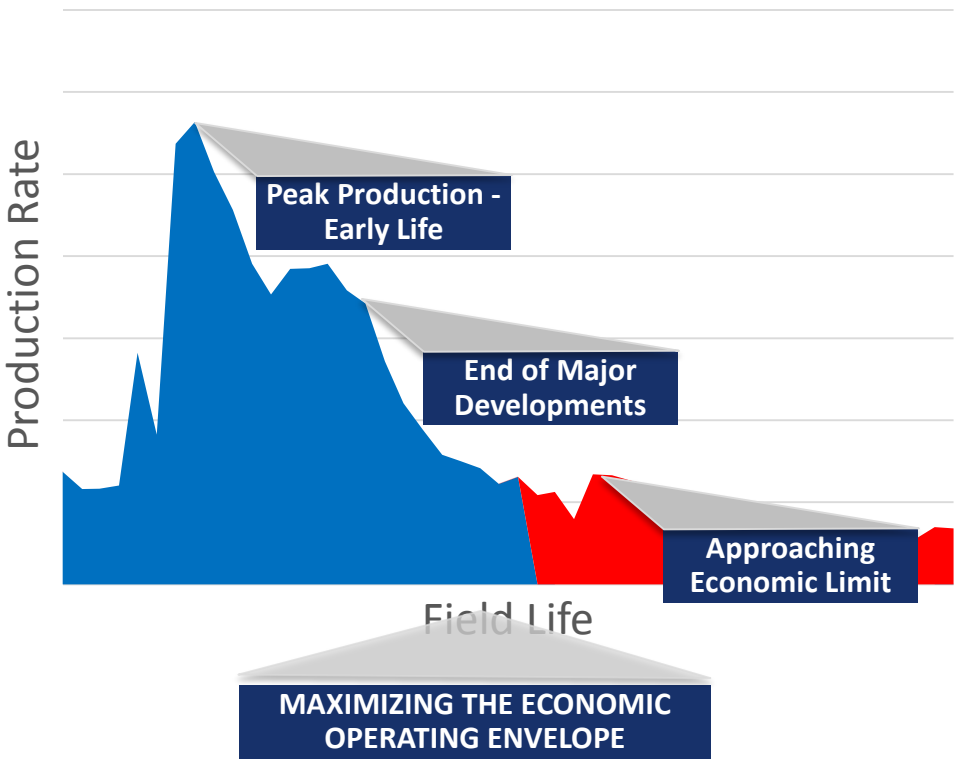
DESIGNING OUT OF HOPE?

Single Governing Case for Design

- Forecasted across entire project life
- Considers EOR, Late Life, Peak Rate

- BSEE reports in 2016 Utilization is 24.8% of capacity

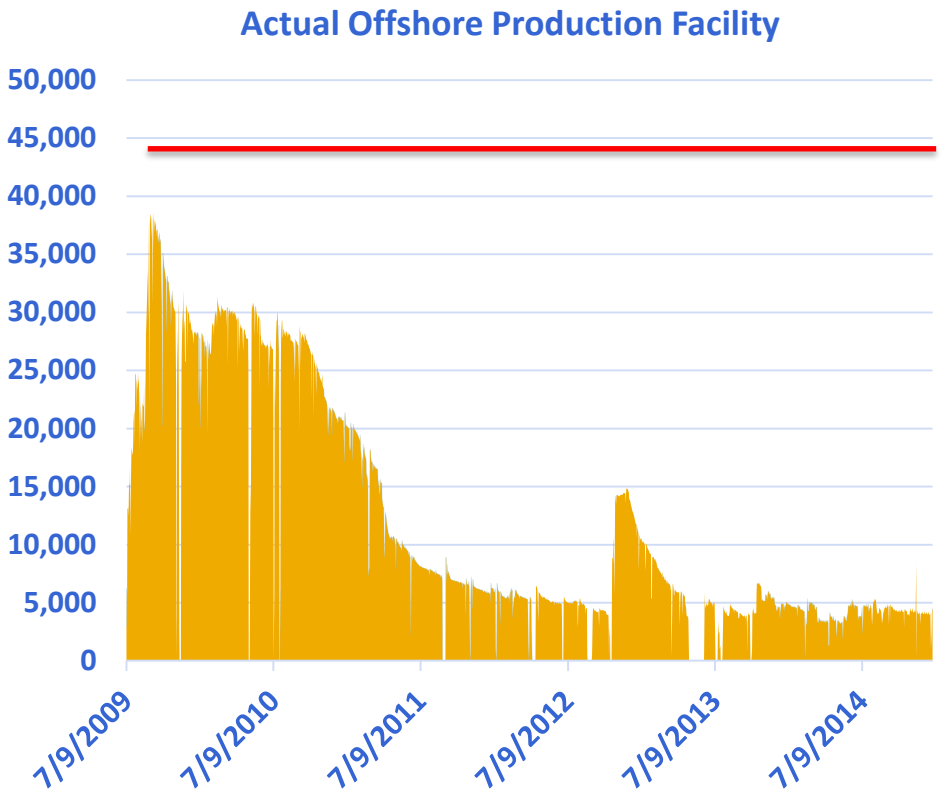




Project Impact?

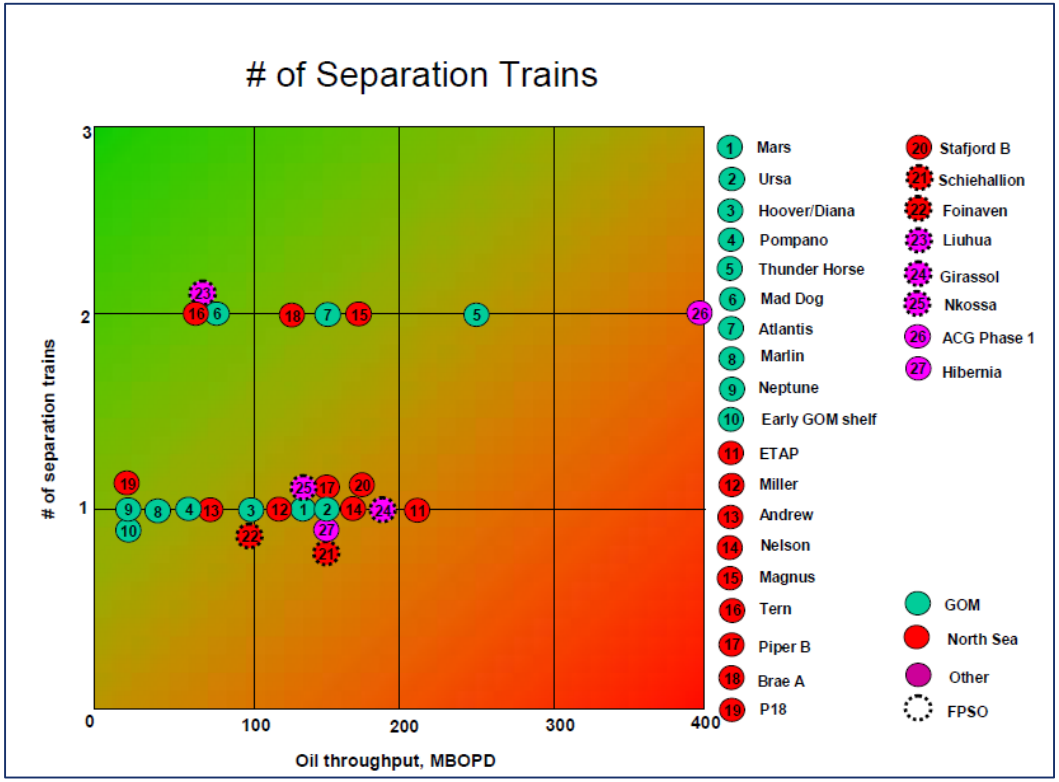
Mega-Projects in Oil & Gas

- 60% Cost Overrun
  - 40-50% of Budget - Upstream
  - 70% - LNG and Refining
- 73% Delayed Schedule



FACTORS AFFECTING SEPARATOR DESIGN BASIS

- Q_{oil}, Q_{gas} , Q_{H20}
  - Min / Max Flowrates
- Fluid Properties
  - ρ, μ, γ, Emulsion Behavior
- Slug Volumes
- Gas Quality / BS&W / OiW
  - 0.1 GAL/MMSCF
- Number of Stages / Trains
- Case Histories / Engineering Bias



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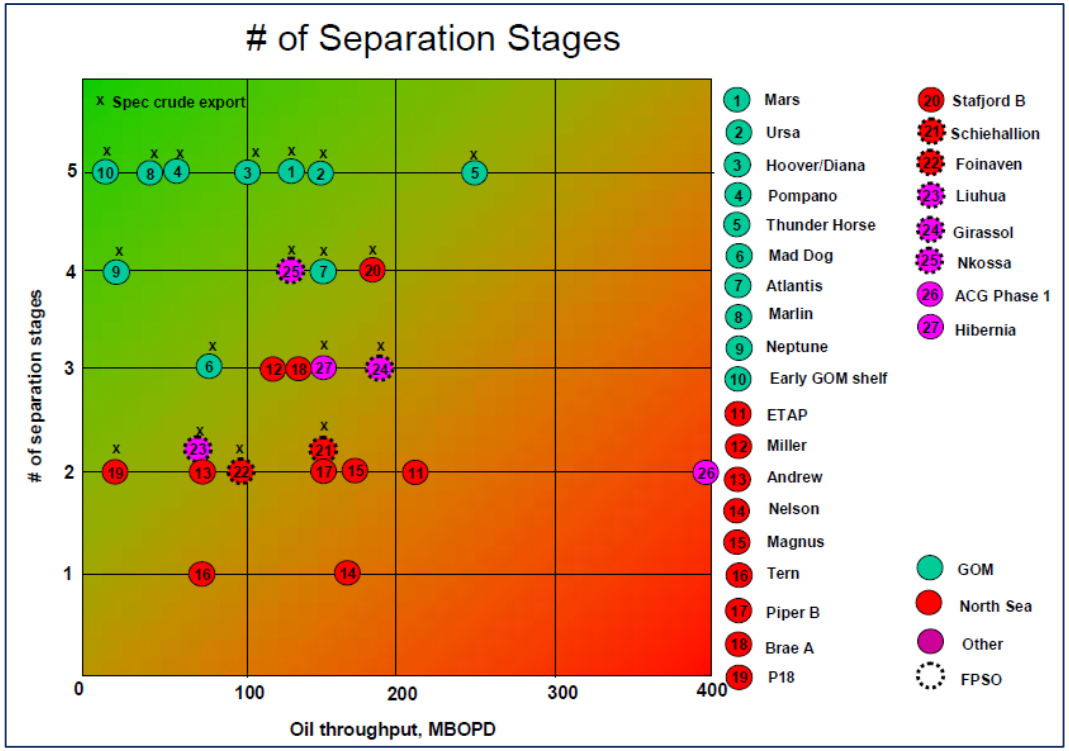

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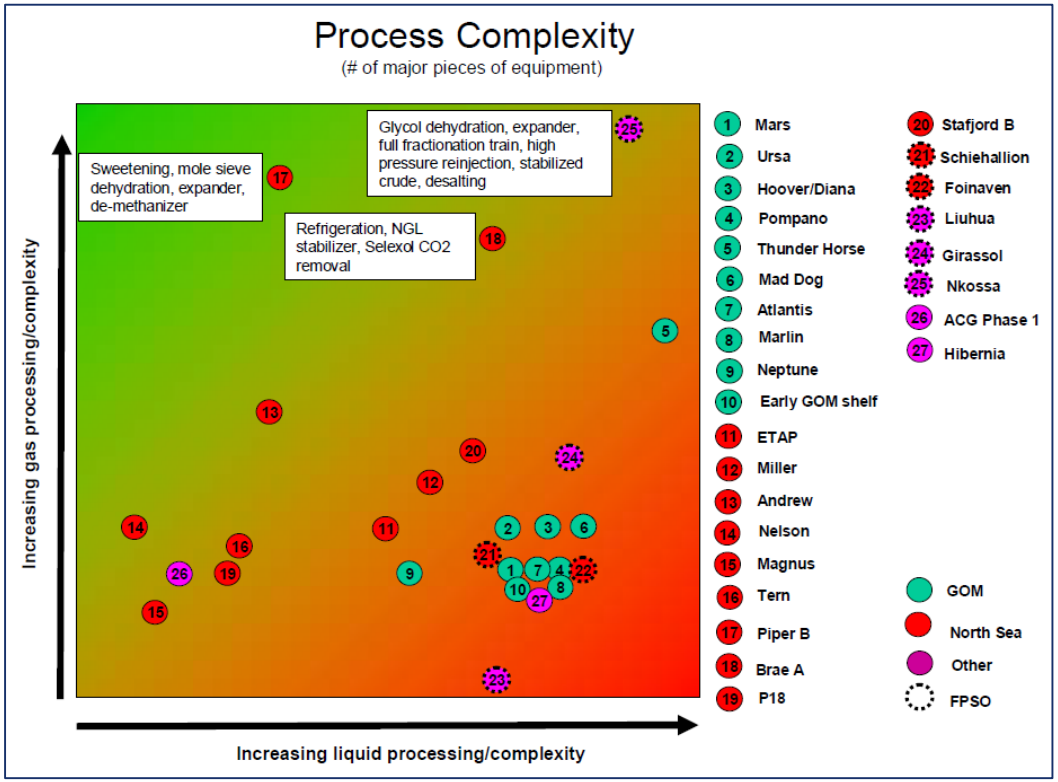
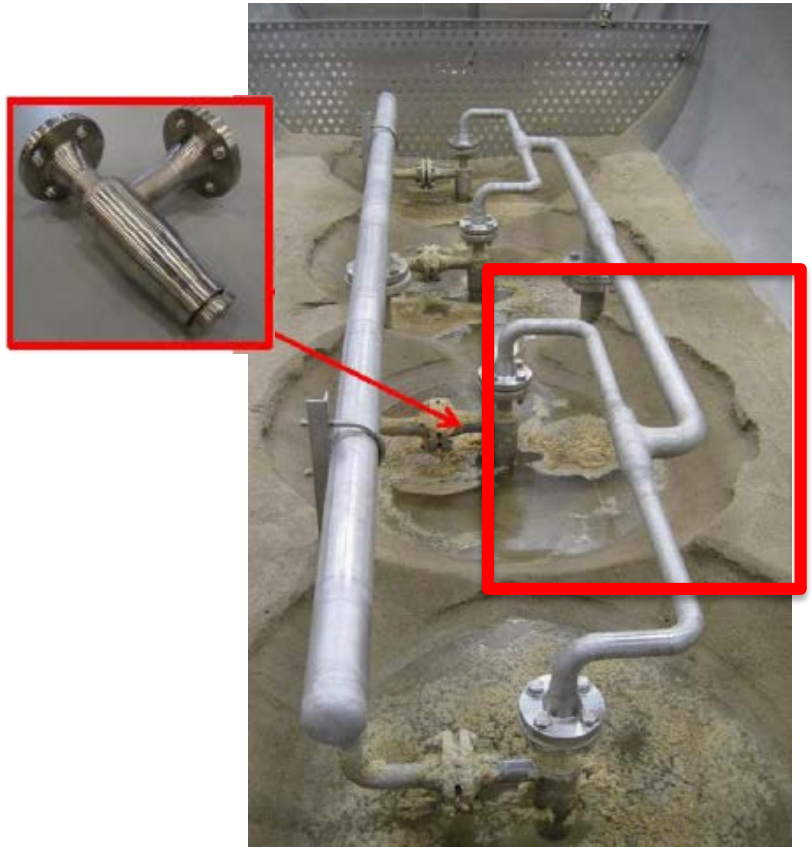


IMPACT OF VESSEL OVERSIZING

- Higher Residence Time
- Larger Capacity for Flowrates
- Larger Void Space for Solids Accumulation
- Increased Weight & Footprint
- Increased Options For Internals
- Increased Complexity



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I.D.	Wall Thickness	Vessel Dry Weight	Hydraulic Test Weight	Volume	ID Increase	Volume Increase	Weight Increase
m	mm	Tonne	Tonne	m3			
2.5	57	40	79	34.36117	100%	100%	100%
3	67	56	112	49.48008	120%	144%	142%
3.5	77	74	152	67.34789	140%	196%	192%

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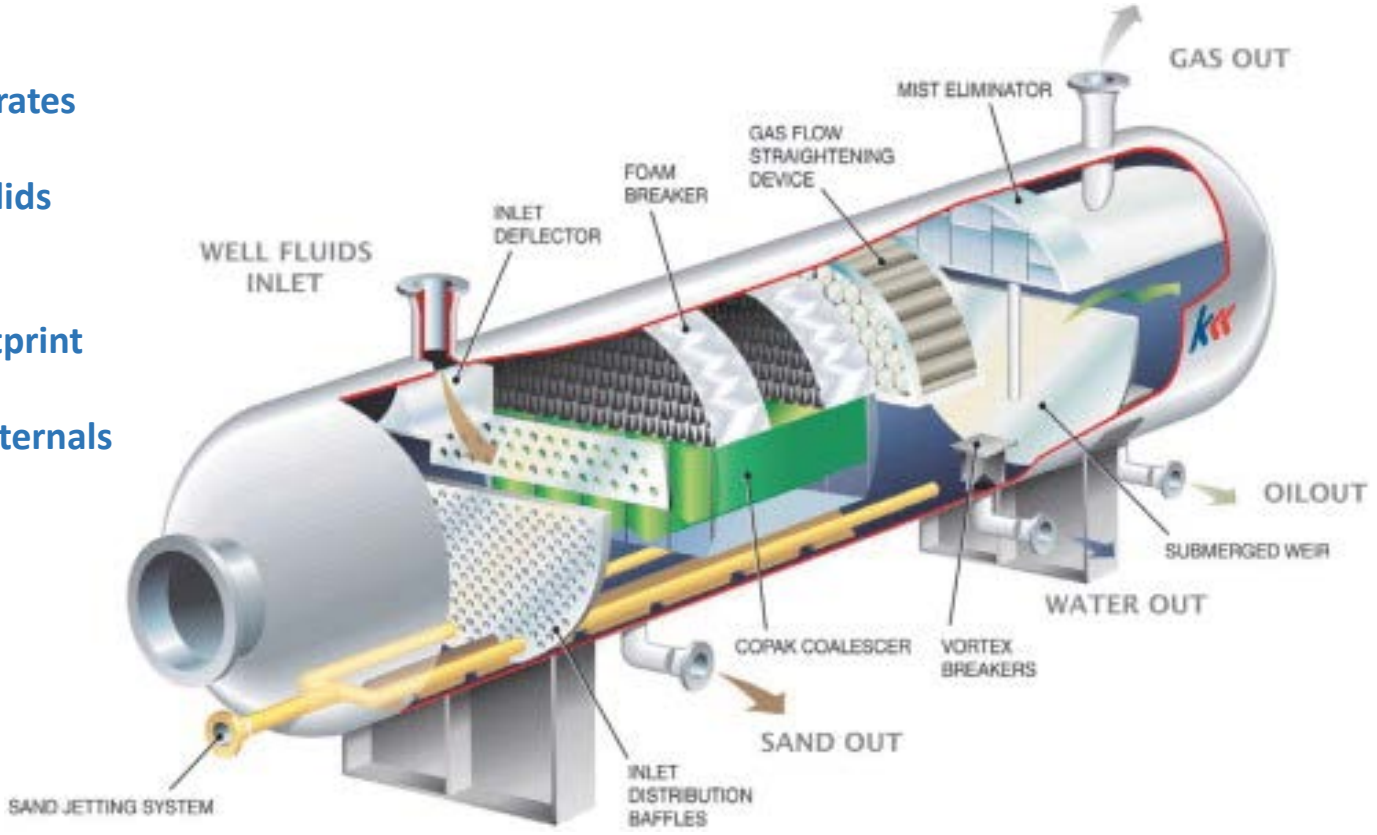
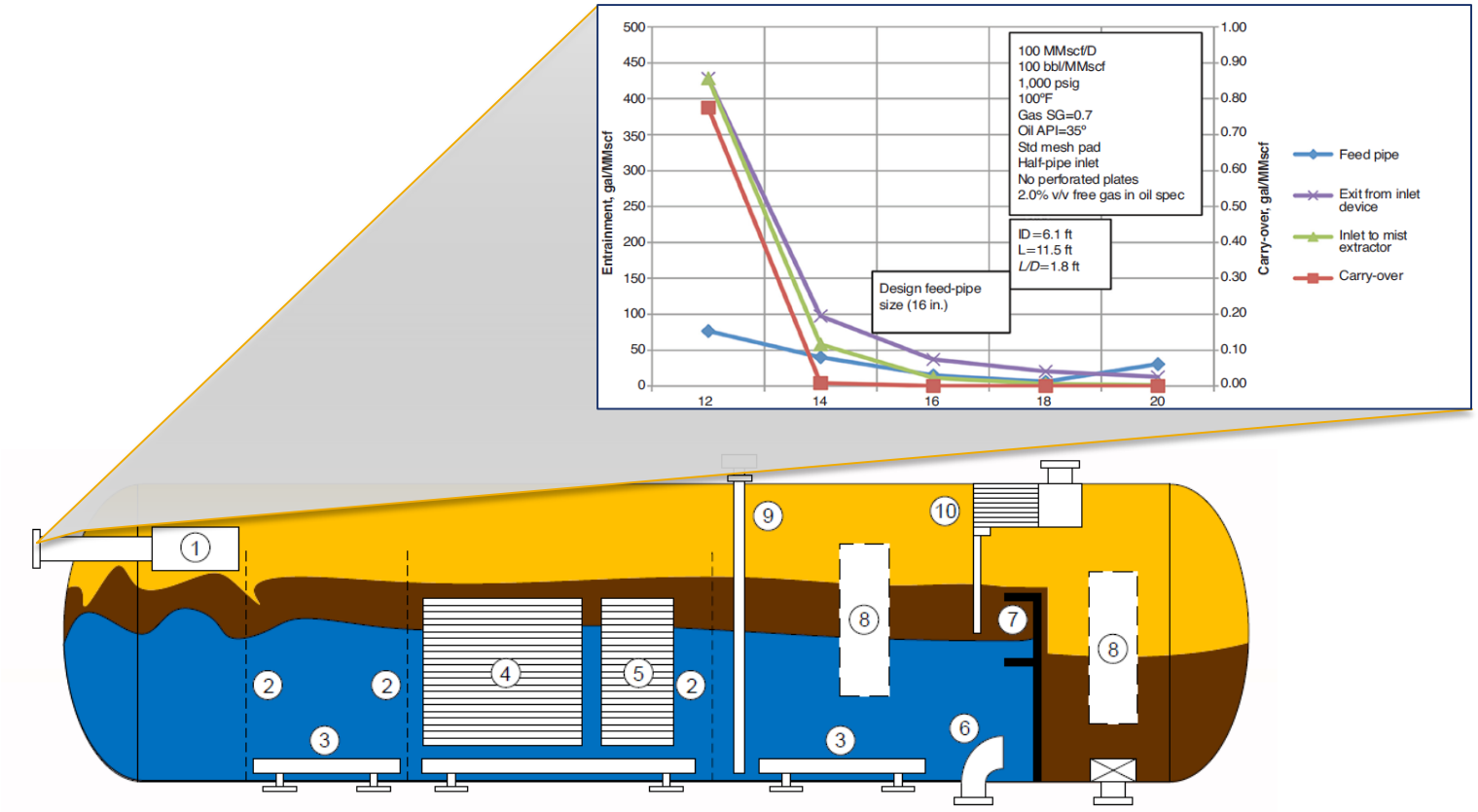


ELEMENTS OF SEPARATORS



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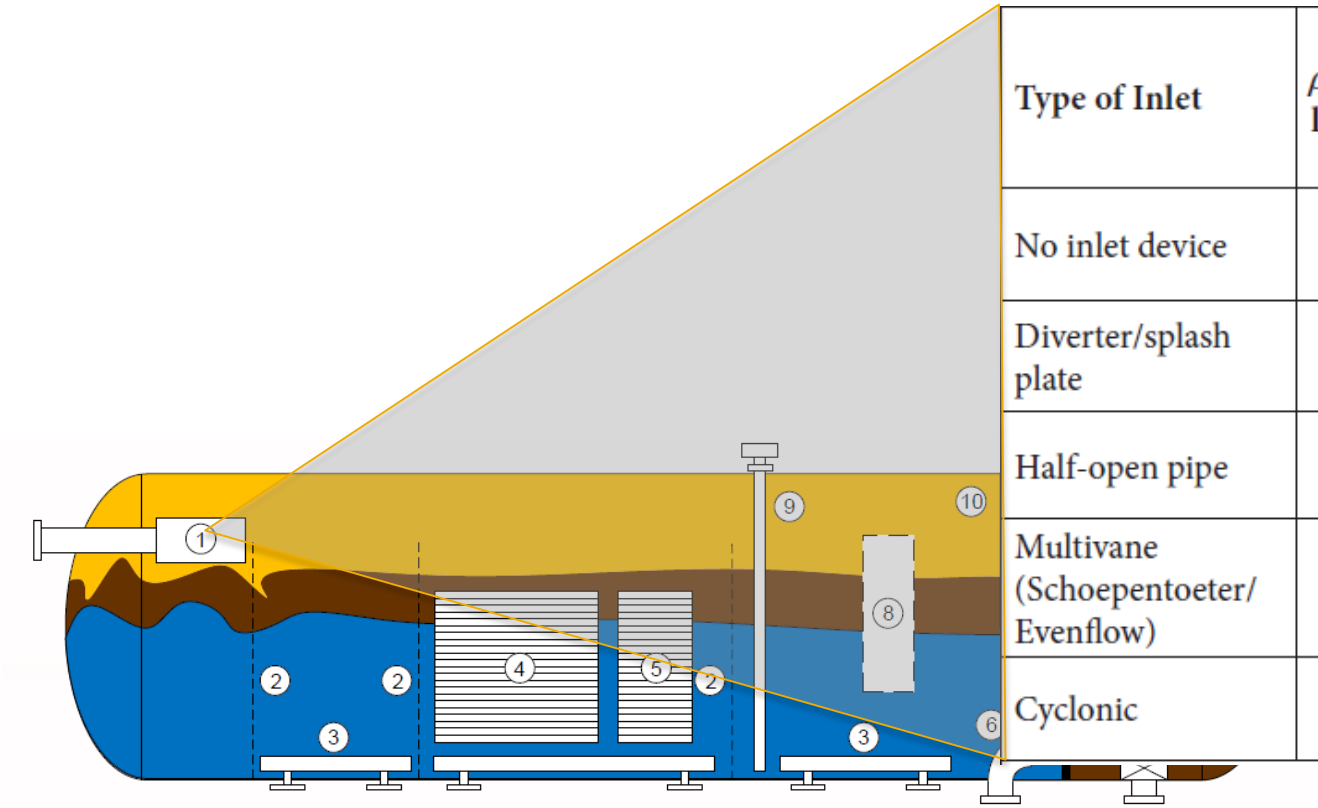

Type of Inlet	ρV^2 Limit, lb/ft-sec^2
No inlet device	700
Diverter/splash plate	950
Half-open pipe	1,400
Multivane (Schoepentoeter/ Evenflow)	4,000
Cyclonic	10,000

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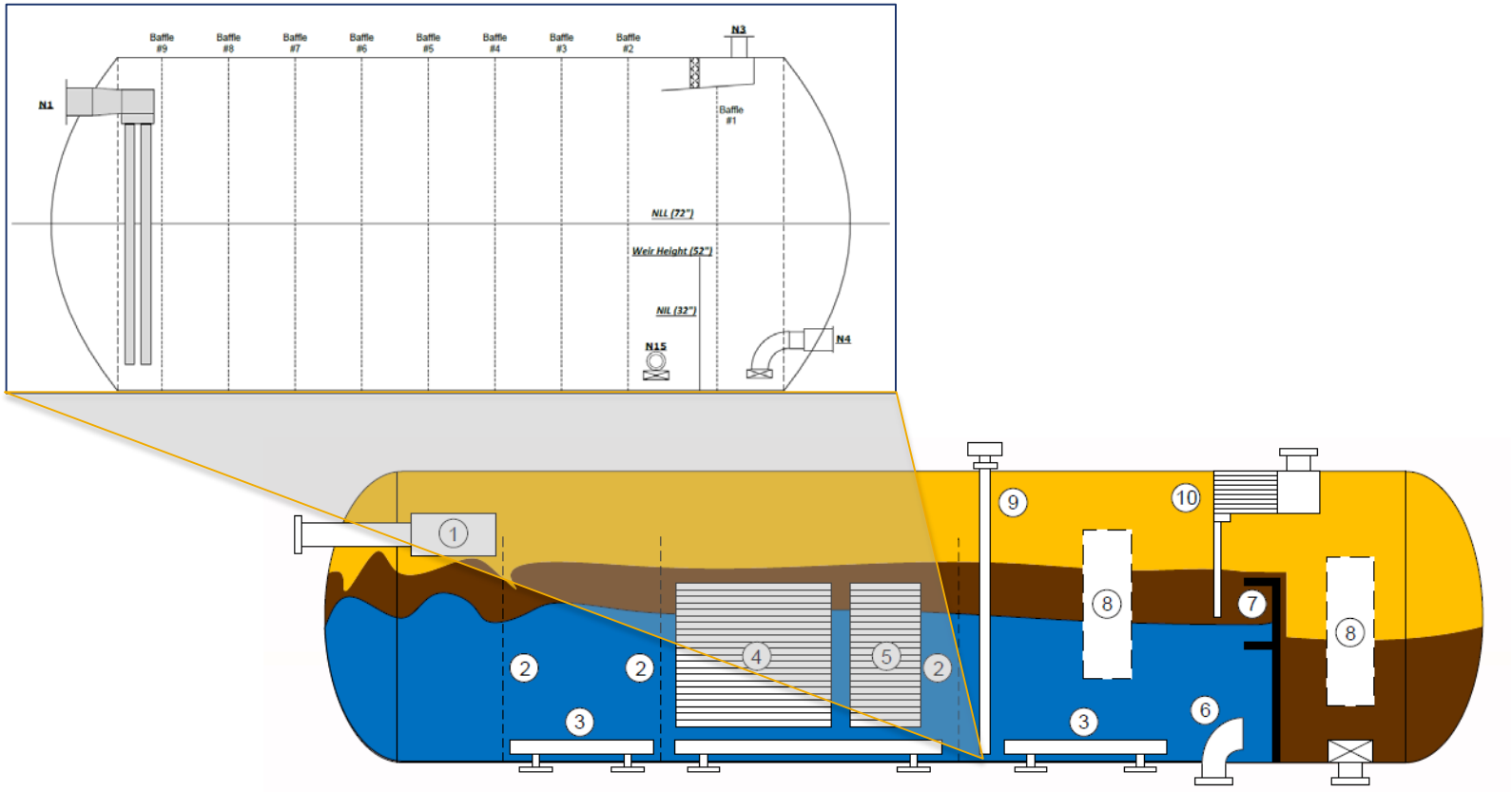
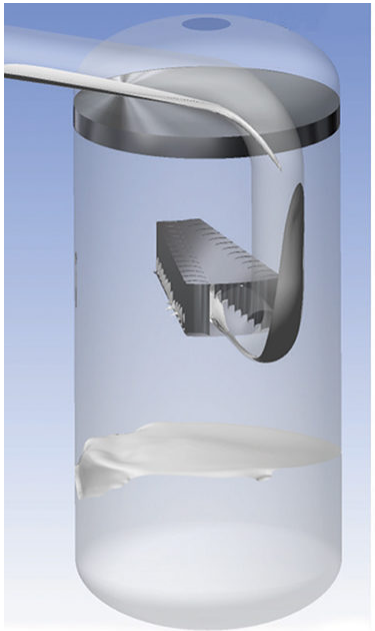
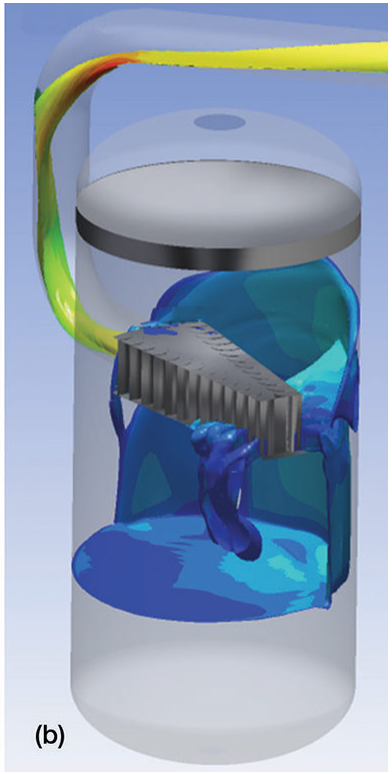


OPTIMIZING PERFORMANCE WITHOUT ADDING SIZE

- **Inlet Piping**



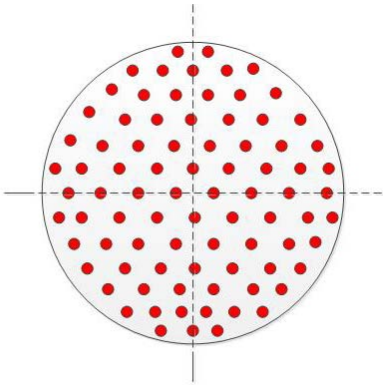
(a)

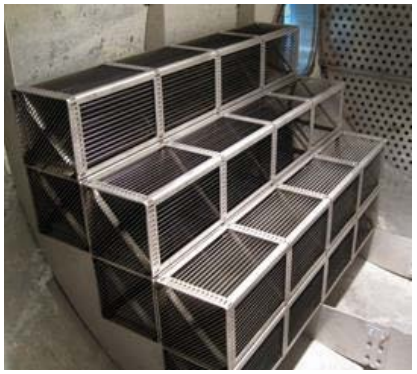


(b)

OPTIMIZING PERFORMANCE WITHOUT ADDING SIZE

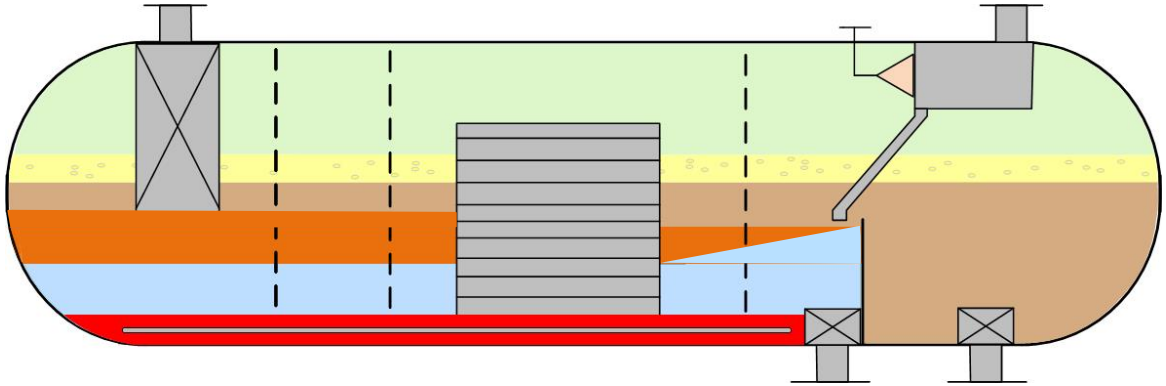
- Inlet Piping
- Flow Calming / Distribution





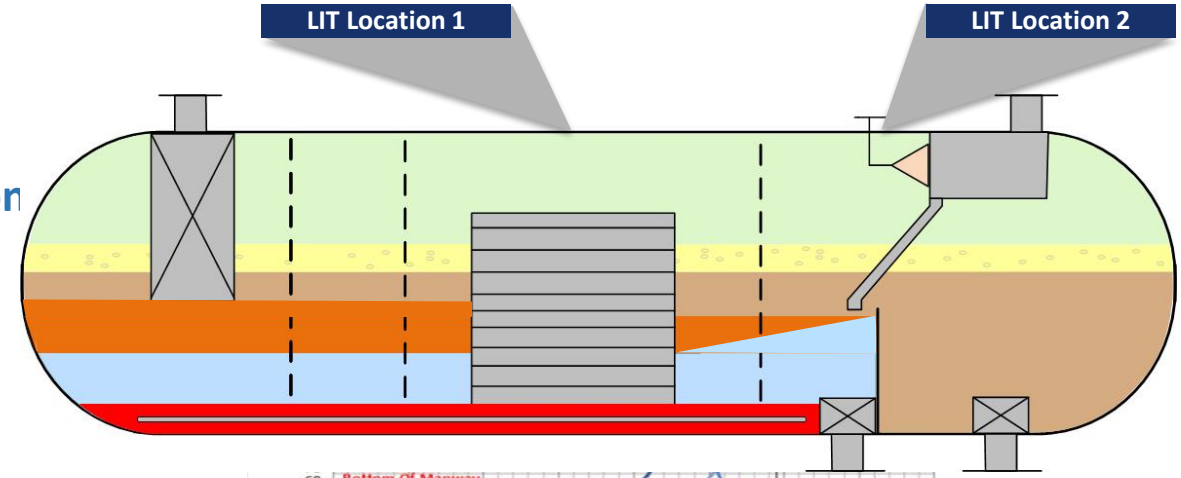
OPTIMIZING PERFORMANCE WITHOUT ADDING SIZE

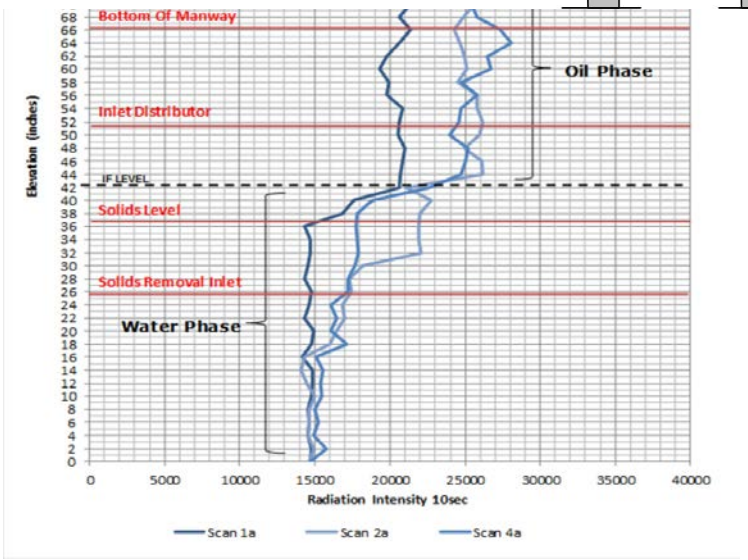
- Inlet Piping
- Flow Calming / Distribution
- Weir Adjustments
- Gas Demisting



OPTIMIZING PERFORMANCE WITHOUT ADDING SIZE

- Inlet Piping
- Flow Calming / Distribution
- Weir Adjustments
- Gas Demisting
- Level Instruments – Locations & Ranges
- Solids Removal





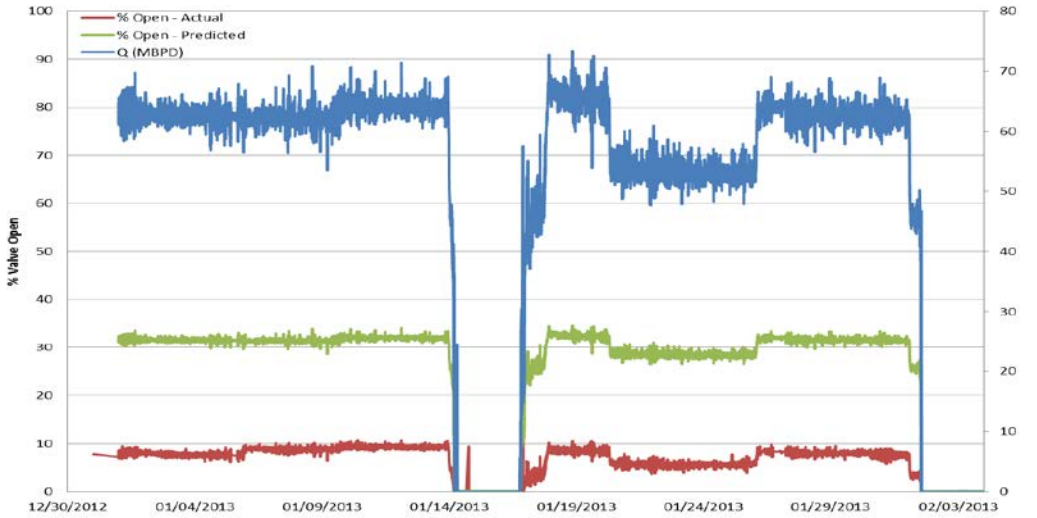
DOWNSTREAM IMPACTS OF OVERSIZING

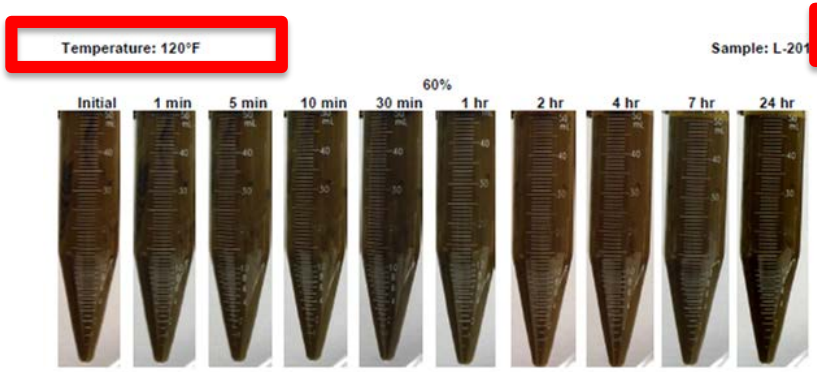
Valve Sizing

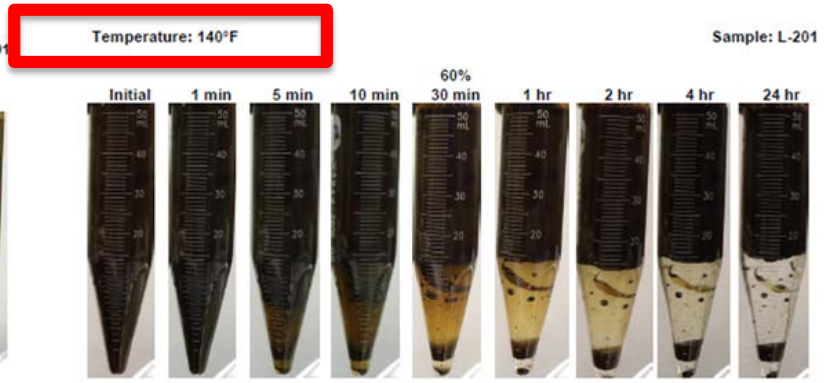
- Higher Shear - Reducing Efficiency
- Multiple Valves in Parallel
- Change Valves Over Field Life

Pressure Relief & Blowdown

Residence Time vs Temperature







UNDERSTANDING ROOT CAUSES OF DEBOTTLENECKING

Rarely is Separator Size the Limiting Factor

- Production Chemistry Knowledge
- Solids Handling & Deposition
- Production Profile
    - Expectation vs Reality

Address the Internals First – Less is Better

DO NOT USE SIZE AS A CRUTCH FOR POOR INTERNALS DESIGN / SELECTION

MOVING TO FIT-FOR-PURPOSE VESSEL DESIGN

- Understanding Fluid Separation Characteristics
- Appropriate Design Margins
- Prioritize Separator Components Individually
- Understand Impact of Maximum Design Case
- Use of Compact & Inline Technologies for Marginal Scenarios
- Quantify Turn-Up / Turn-Down Properties Internals

		24" Schedule 160		24" Schedule 80		30" with 2" W.T.	
		Case 1	Case 2	Case 1	Case 2	Case 1	Case 2
Pipe I.D.	m	0.4905		0.5477		0.6604	
Actual Flow	m3/h	5398	4461	5398	4461	5398	4461
Mixed Density	kg/m3	114.5	91.7	114.5	91.7	114.5	91.7
Mixed Phase Velocity	m/s	7.93	6.56	6.36	5.32	4.38	3.62
Inlet Momentum	kg/m/s2	7211	3945	4638	2594	2194	1200
Condensate Surface Tension	dyne/cm	6					
Max. Condensate Droplet Diameter	microns	416	566	566	727	956	1301
Condensate Surface Tension	dyne/cm	12					
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Condensate Surface Tension	dyne/cm	20					
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LOOKING BACK TO LOOK AHEAD

- Single Data Point Drives Most Designs
- Fear of Under Designing Prevalent Across Industry
- We Are Adding Margin On Top of Margin – Turndown is a Misnomer
- ONE Oversized Design Case Affects The ENTIRE Facility
- Early Data on Fluid Behavior Eliminates Tendency to Overcompensate
- The Move to SSTBs Changes The Way We Design Facilities
- Evaluate the ENTIRE Lifecycle - There is More Value in the Tail than People Realize

Acknowledgements / Thank You / Questions

(James Deaver, 2016 AIChE/SPE Workshop)