

Multiphase RST Technology

IRIS™ Inline Rotary Separator / Scrubber



Rotary Separator Turbine Technology Solutions

Oil Dominated Systems

Tri-Phase Rotary Separator Turbine



Bi-phase Rotary Separator Turbine

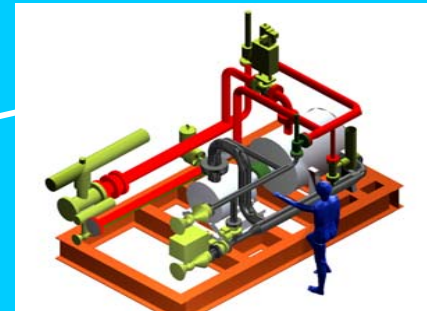


Gas Dominated Systems

IRIS Inline Rotary Separator



One or Two step
Processing
<29 ppm oil in water
0.5% BS&W
99.99% gas separation



WSPR
Power
Recovery
Unit

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Scrubber Technology Comparisons

Impact Based
2.75' Ø x 7.5' S/S
9,300 lbs. Empty
9,900 lbs. Operating
< 1psid



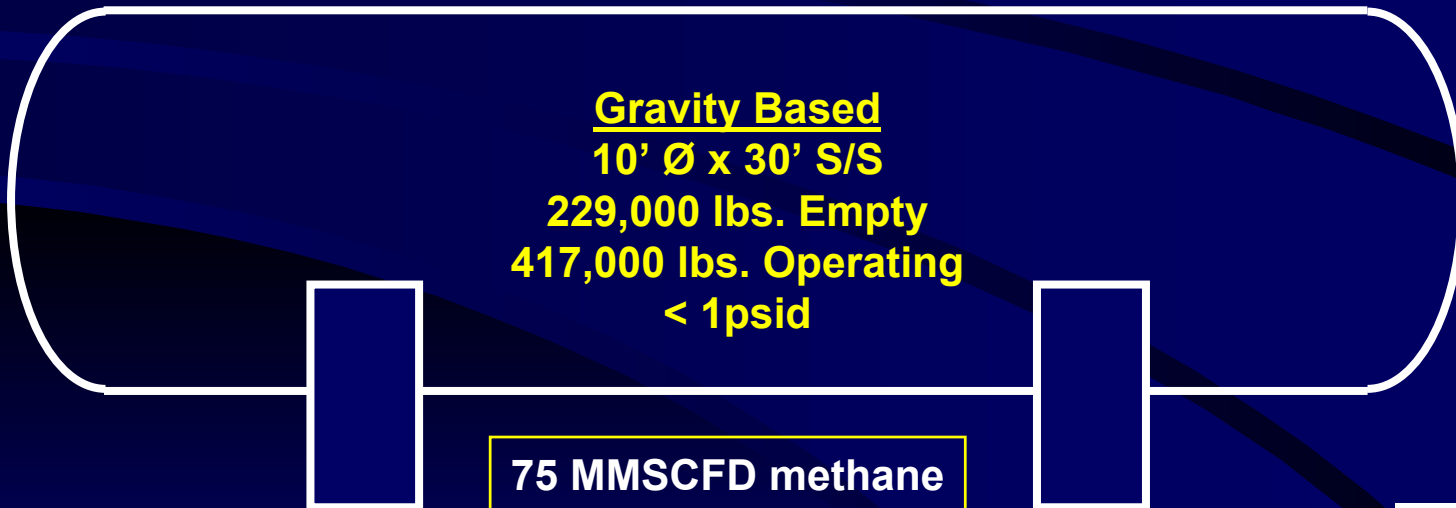
Cyclonic Based
2' Ø x 8.5' S/S
5,900 lbs. Empty
6,200 lbs. Operating
2.2 psid



Rotordynamic Based
23" Ø x 32" OAL
760 lbs. Empty
784 lbs. Operating
36 psid



Gravity Based
10' Ø x 30' S/S
229,000 lbs. Empty
417,000 lbs. Operating
< 1psid



75 MMSCFD methane
1200 psig @ 120 °F
10 µm water droplet

Competitive Technologies

Device	Separator no Internals	Filters	Mist Eliminator	Vane Pack	Multi- cyclones	Axial Flow Cyclones	Compact Cyclone Degasser	IRIS
Pressure Drop	1	8	2	3	5	4	6	7
Gas Capacity @ Low Pressure	8	4	6	1	5	2	7	3
Gas Capacity @ High Pressure	8	4	7	5	3	2	6	1
Turndown	4	1	5	7	3	6	8	2
Solids Handling	3	8	7	5	1	6	2	4
Droplet Removal @ Atmosphere	20-50 µm	0.2 µm	10 µm	8 µm	6 µm	7 µm	7 µm	< 5 µm
Foam Handling	7	?	6	5	3	4	1	2
Waxes/Hydrates	5	8	7	6	1	4	3	2
Equipment Size & Weight	8	4	7	6	5	3	2	1
Device Cost	1	8	2	4	5	6	7	3
System Cost	8	7	6	5	4	3	2	1

Table from “Developments in Gas/Liquid Separation Technology”, by A. Sterner

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Inline Rotary Separator Turbine

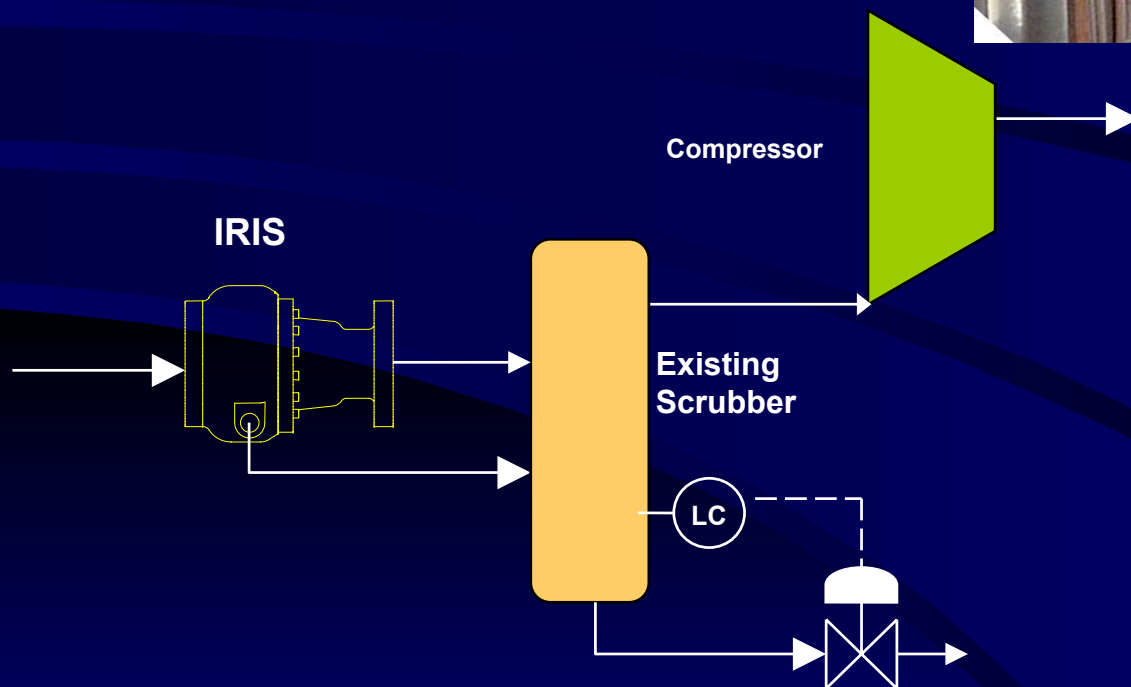
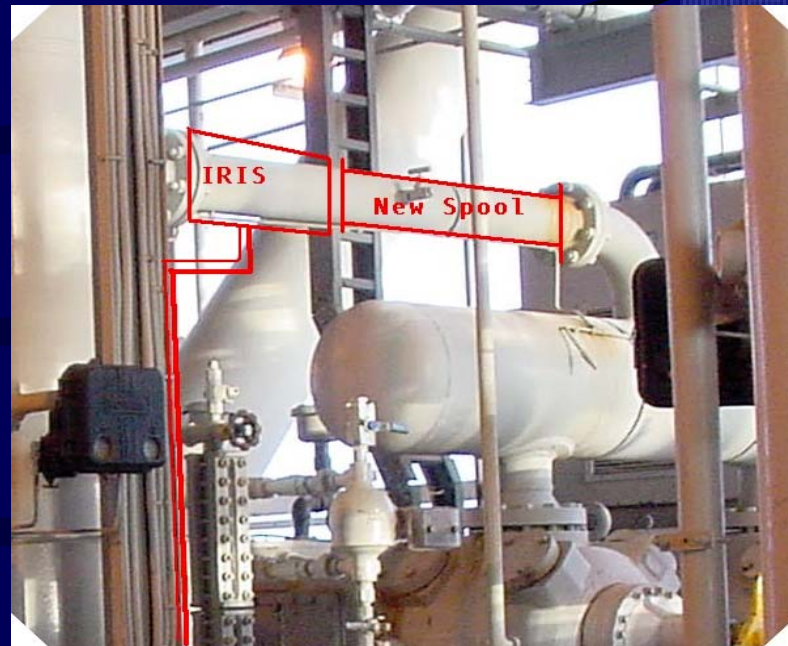
Typical Applications

- **Gas Transmission & Metering**
- **Standard or Secondary Scrubber**
- **Compressor Suction**
- **Compressor Discharge and Interstage Scrubbing**
- **Contactors Tower Inlet/Outlet**

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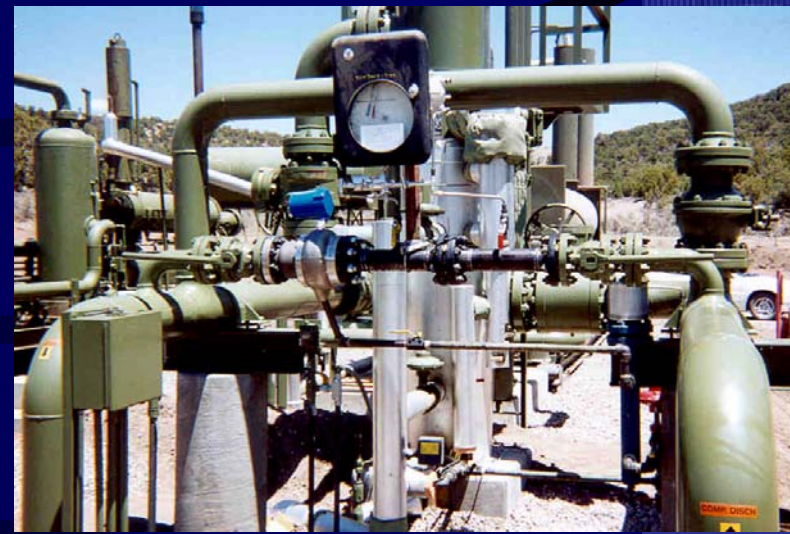
..Typical Application

Improve Suction Scrubber Performance

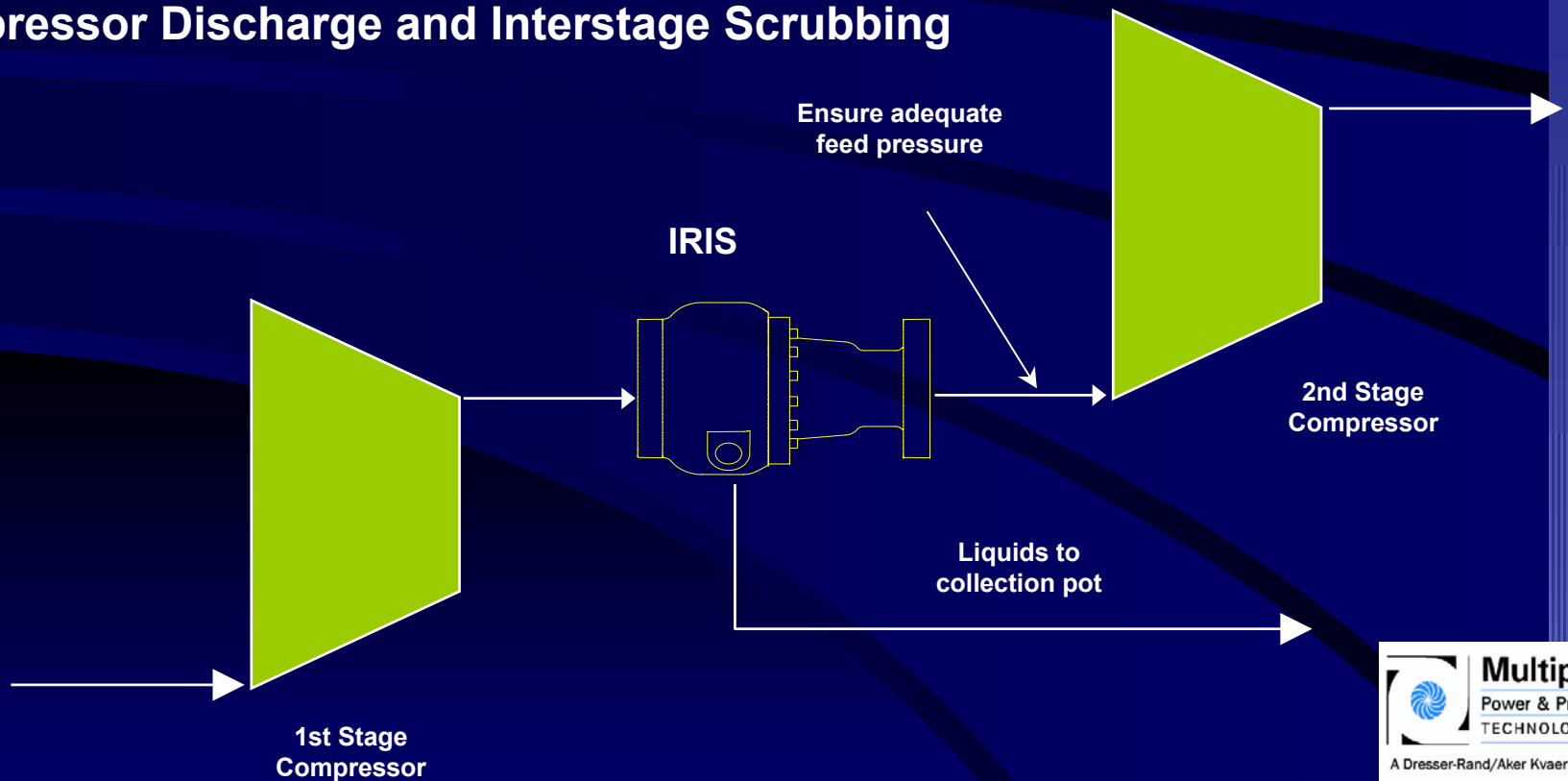


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..Typical Application



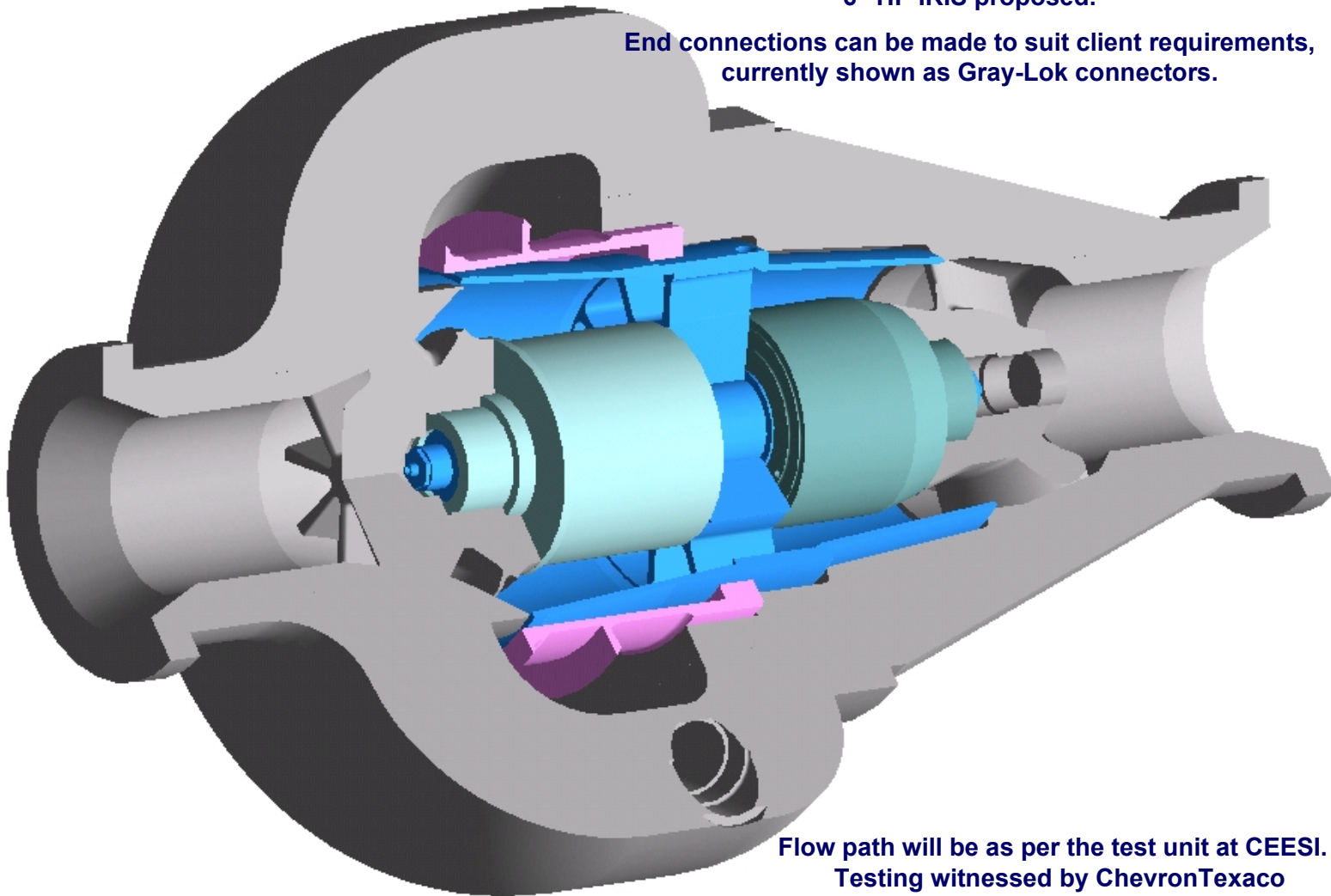
Compressor Discharge and Interstage Scrubbing



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6" HP IRIS proposed.

End connections can be made to suit client requirements,
currently shown as Gray-Lok connectors.



Flow path will be as per the test unit at CEESI.
Testing witnessed by ChevronTexaco

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..in Hardman Resources' owned Woodada Gas Plant,
Western Australia

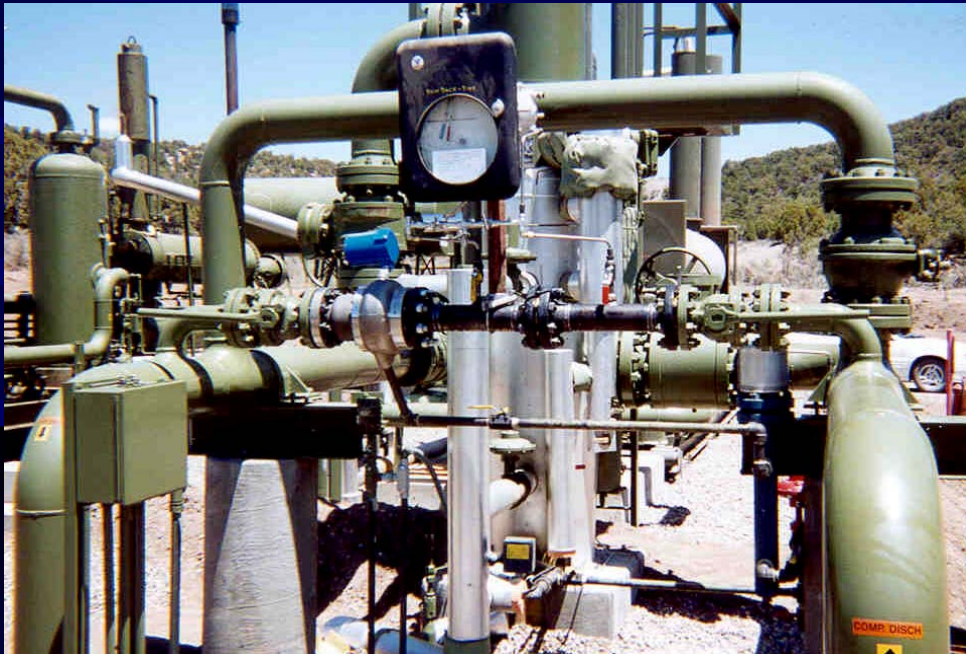


•Current Operation:

- Model – IRIS-6030
- 200 to 350 psig sales quality natural gas
- Flow 3-4 MMSCFD current
- Removing condensate and water / glycol carryover from sales gas, upstream of sales gas compressors
- Removing ~ 2 US gal/week liquids
- Operating between 7 - 9,000 rpm
- Clocked over 7000 hours operation

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..in Red Cedar Gas Gathering, Pump Canyon Compressor Station - Durango, Colorado



•Field Operation:

- Model – IRIS-6030
- 300 to 350 psig sales quality natural gas
- Flow 5-6 MMSCFD current
- Removing compressor oil carryover from sales gas, upstream of glycol dehydration
- Removing ~ 11 US gal/day
- Operating between 9 - 11,000 rpm
- 1800 hours operation before change out

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..MARATHON Ewing Bank 873 Platform, Gulf of Mexico

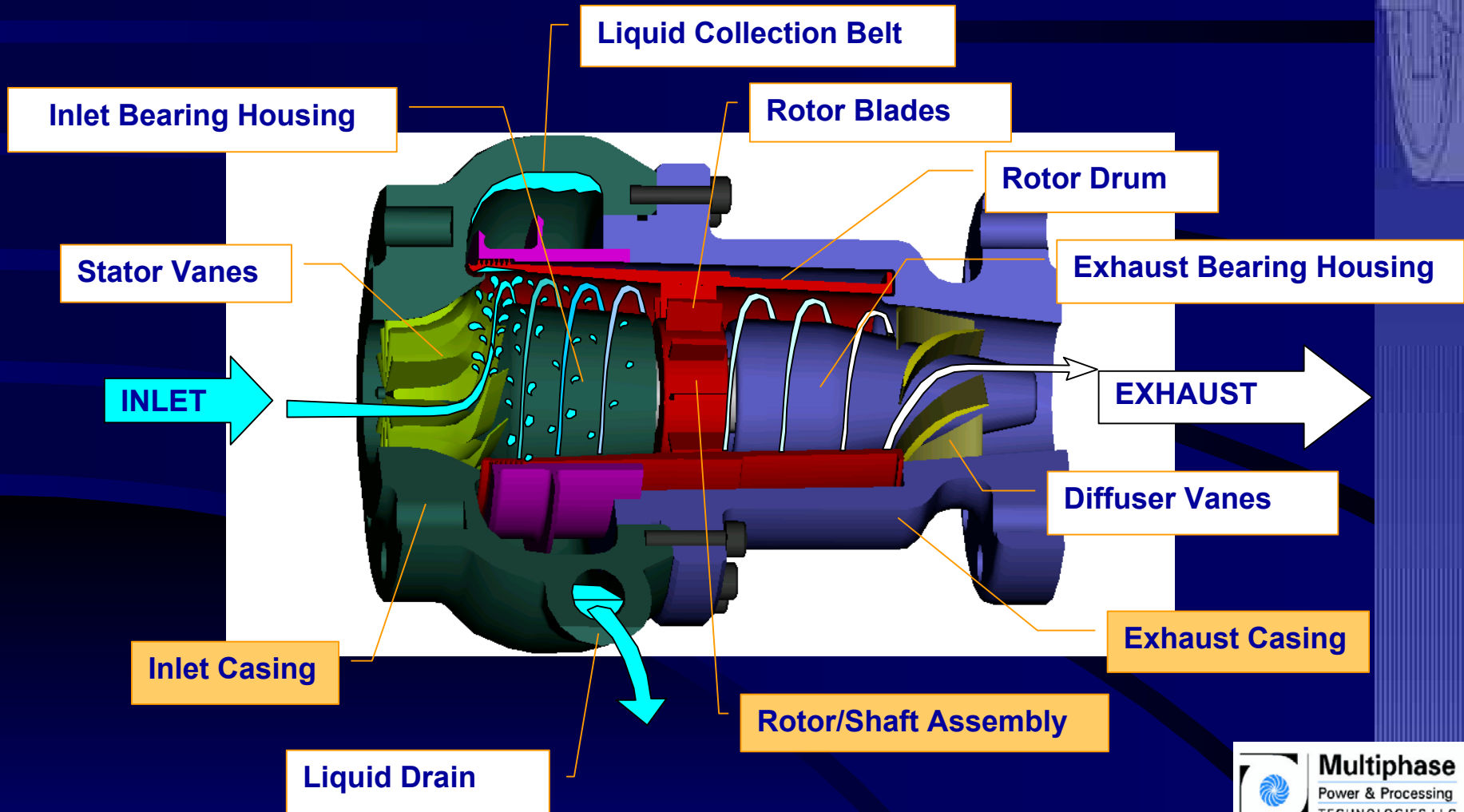


•Current Operation:

- Model – IRIS-6030
- 100 to 130 psig export gas
- Flow 0.5-1.5 MMSCFD current (flow trimming plates installed)
- Removing oil and water carryover, upstream of export gas compressor
- Removing ~ 3 BPD liquids
- Operating between 4 - 5,000 rpm
- 700 hours operation to end of Feb 03

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Mechanical Design



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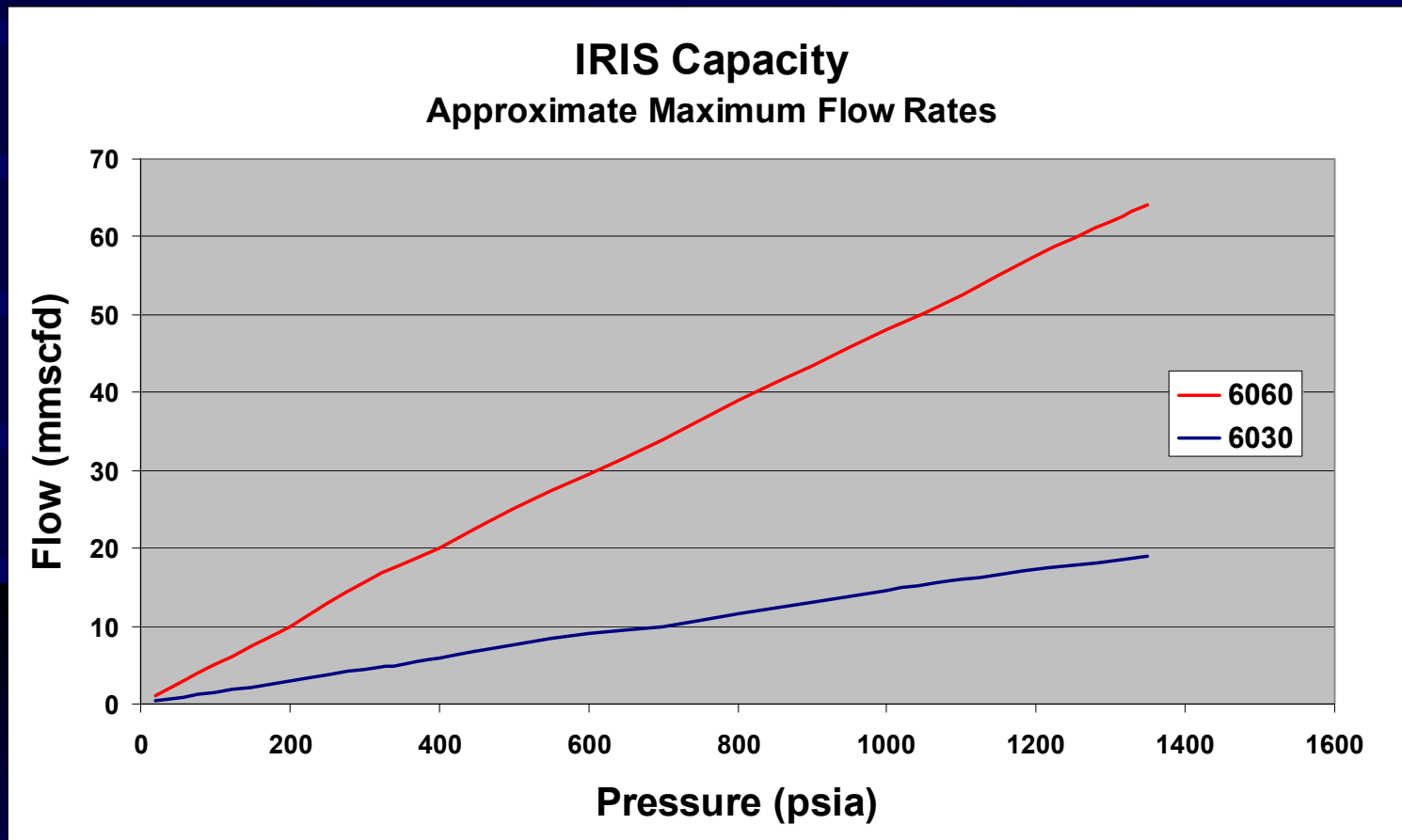
Product Benefits / Attributes



- **Compact/Light Weight**
- **Inline Design**
- **Retrofit Capabilities**
- **High Separation Efficiency**
- **High Liquid Capacity**
- **High Turn Down Ratio**
- **Standard NACE Materials**
- **Minimal Instrumentation**
- **Fast Delivery**

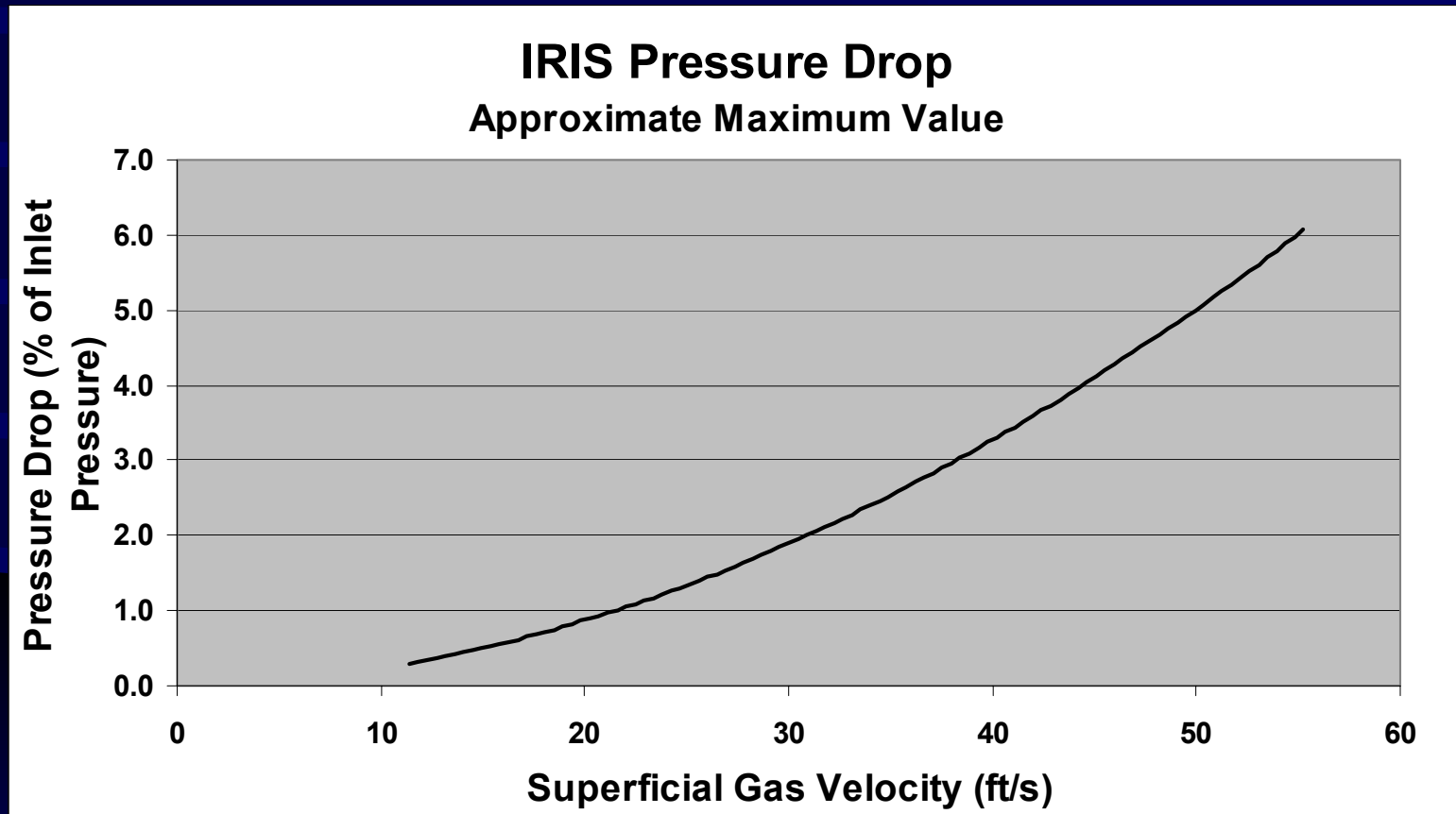
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Quick Sizing Guidelines – Gas Capacity



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Quick Sizing Guidelines – Pressure Drop





Operating Parameters of Available Models

Performance Parameters:

- **Inlet Pipe Velocity: 15 – 60 ft/s**
- **Pressure Drop: 0.5 – 5 % of Inlet Pressure**
- **Liquid Capacity: 40 % by Mass (maximum)**
- **Separation Performance: 99.99 % liquids $\geq$ 5 micron**

Standard Specifications:

- **IRIS-6030 – 3" nominal diameter, design rating up to 600# ANSI**
- **IRIS-6060 – 6" nominal diameter, design rating up to 2500# ANSI**
- **316 SS construction (NACE compliant)**

Options Available:

- **Raised Face, Grayloc and Compact Flanges**
- **Flow Trimming Plates**
- **Instrumentation**

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..Long-term test at Chevron Texaco's Laredo Gas Plant - Texas



•Test Parameters:

- Prototype IRIS
- Operated from Oct 1999 - Jun 2000
- 4700 hours of operation at well head
- Pressure 1100 psi
- Gas Flow 8 MMSCFD
- Liquid Flow 117 bbls/day
- 99.9% Separation Efficiency
- Foam & sand handled

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..Independent Performance Testing at the Colorado Engineering Experiment Station (CEESI) - Colorado



•Test Parameters:

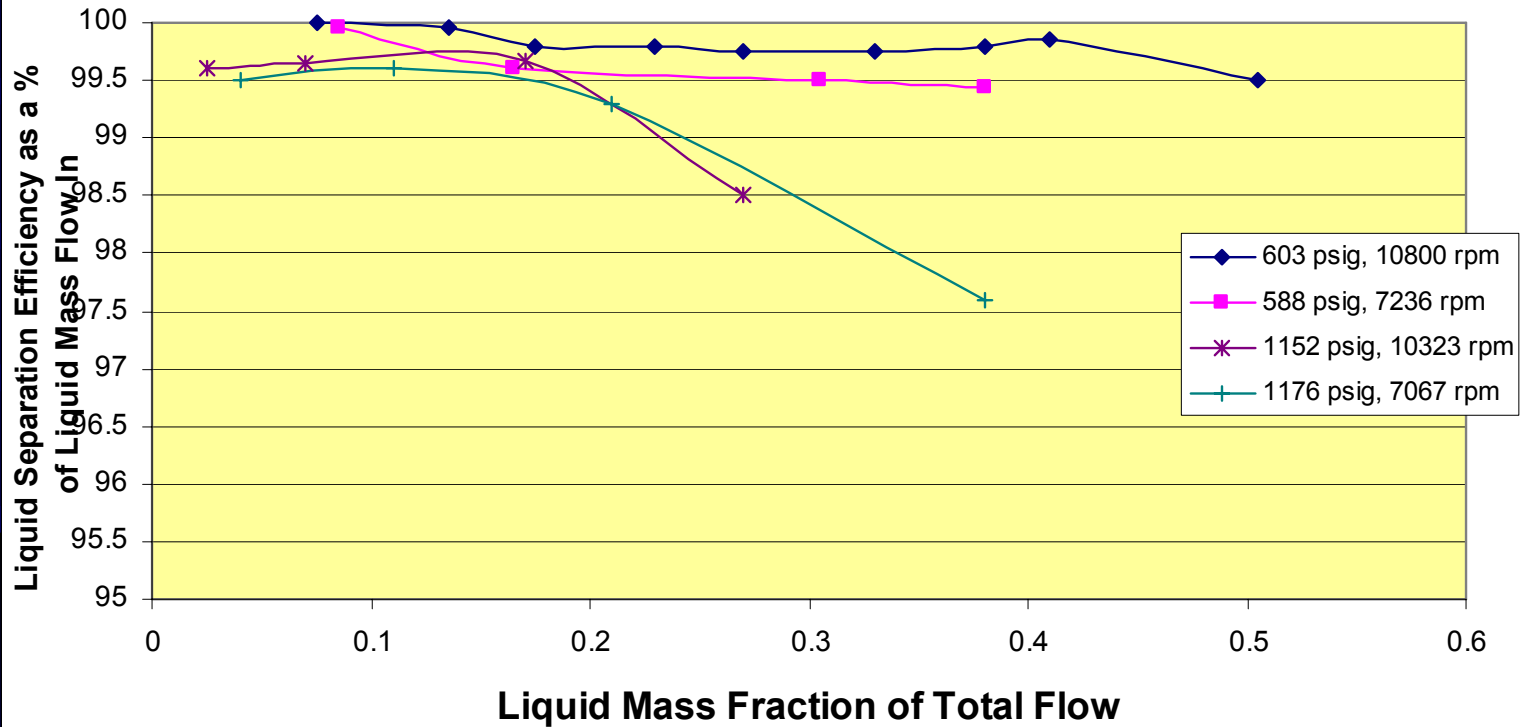
- IRIS-6030 & IRIS-6060 models tested
- 100 to 1200 psig.
- Pipeline quality natural gas
- Pure Decane liquid (SG ~0.72)
- Separation performance measured on liquid mass balance
- All testing witnessed by ChevronTexaco r



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..Raw Data from CEESI Testing

IRIS-6030 Separation Efficiency Curves, Liquid S.G. ~ 0.72 (Decane):



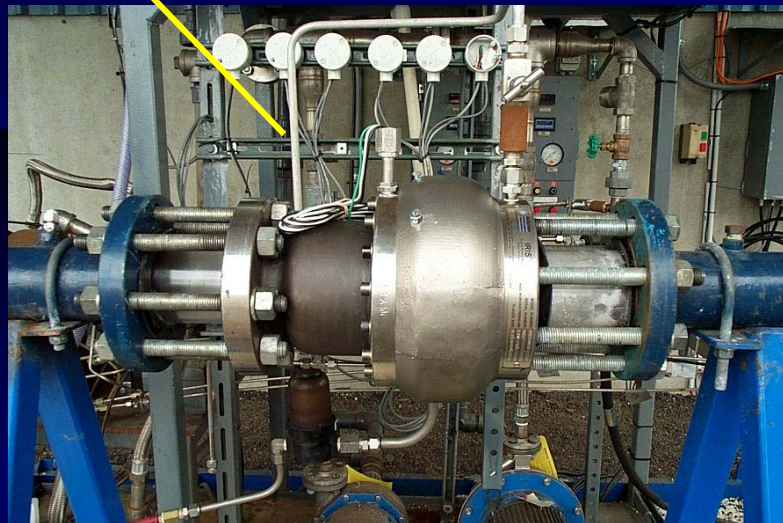
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Perth Test Loop - Low Pressure Testing



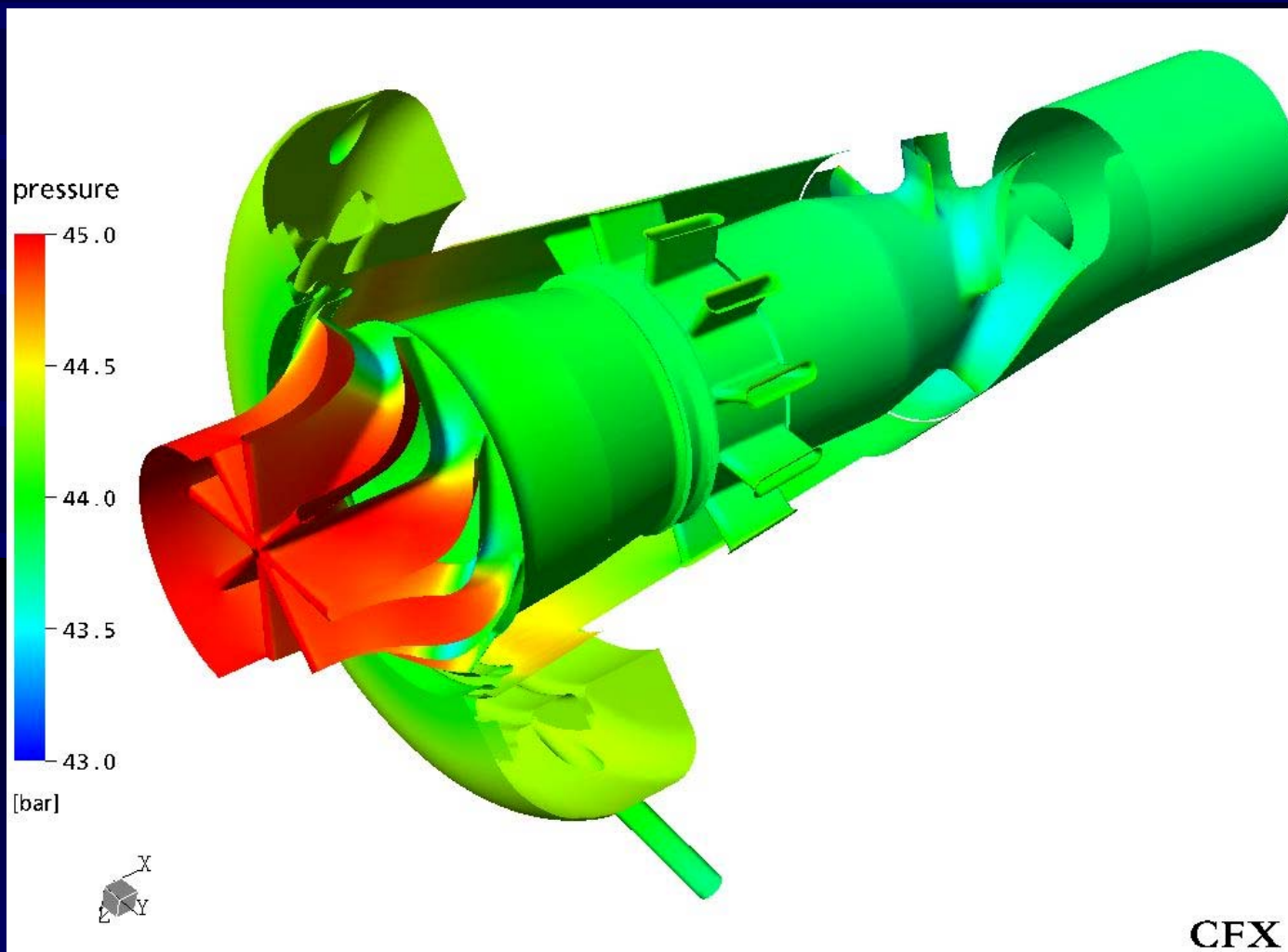
•Test Parameters:

- All four IRIS-6030 models tested
- Tested from Jan to Oct 2002
- 10 to 60 psig
- Compressed air
- Water vs. Exxsol D60
- Liquid droplet size investigation



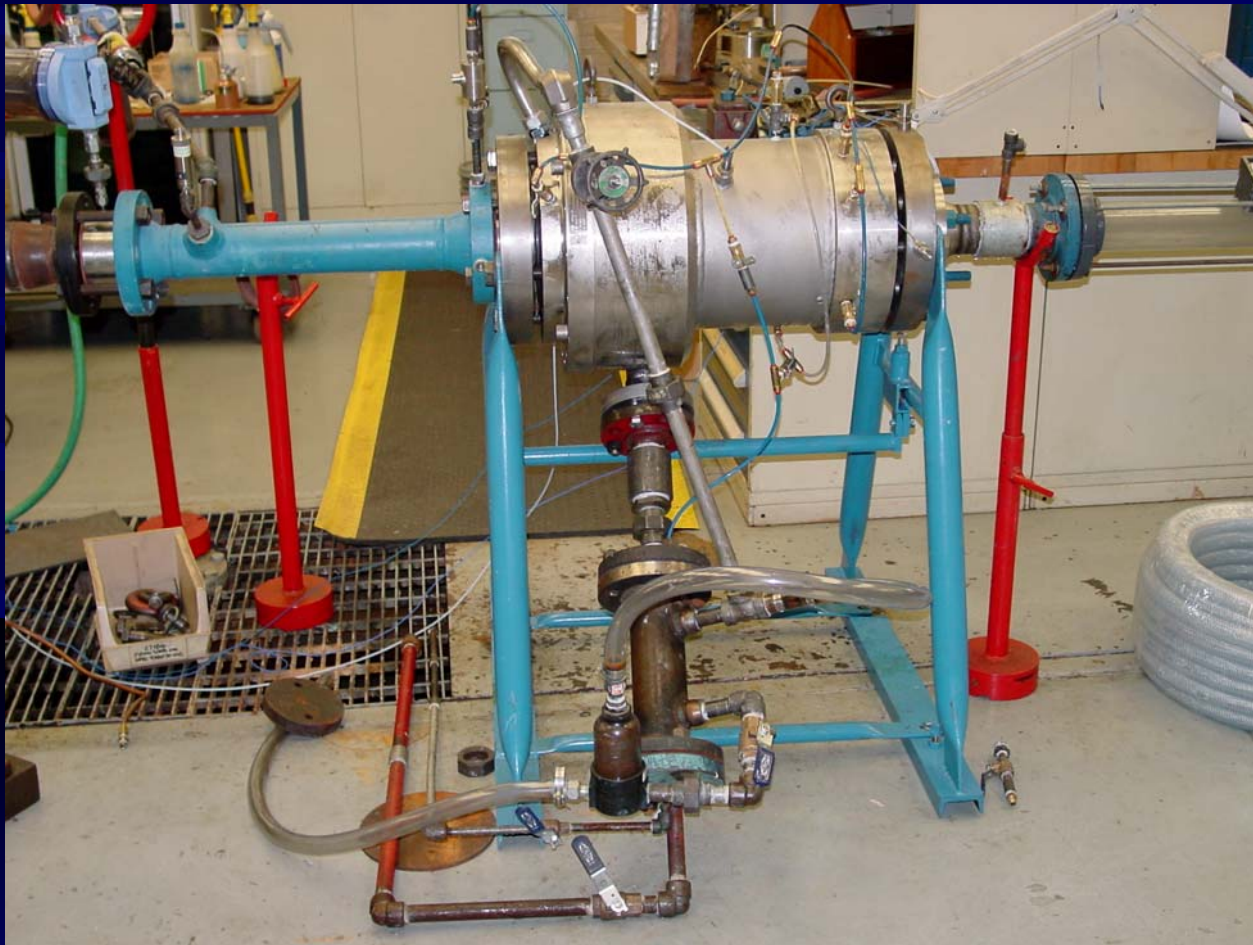
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..6" IRIS development - pre CEESI Testing



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..6" IRIS in Wellsville Test Loop - pre CEESI Testing



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Operational envelopes for selected models

	3" 600#	6" 600#	6" 2500#
Maximum operating pressure (psig)	1480	1480	6170
Pressure Drop (%)	1-5	1-5	1-5
Operating Temperature (F)	40-200	40-200	40-200
Weight (lbs)	160	605	1600
Overall length (in)	13.38	36	36
Maximum Inlet pipe velocity (ft/sec)	80	80	80
Nominal rotor speed (RPM)	10,000	6,000	6,000
Maximum liquid volume percent (%)	4	4	4
Maximum gas flow * MMSCFD	12	80	80

* dependant on superficial pipe velocity

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Inline Rotary Separator Turbine

Questions?

