EPCM Condensed: Going from an equipment need to an Operation Solution with no time to spare

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The Problem

- A Strategic client approached Canwell Enviro Industries on January 17th, 2013
- ERCB Regulation for Sulphur Recovery
- Objective: To treat sour gas at client's Facility to meet the ERCB sulphur recovery requirements.

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Sulphur Recovery Guidelines for Alberta

ERCB ID 2001-03

1 – 5 t/d = 70% recovery

Initial Schedule

- Client approached Canwell January 17th, 2013
- Requested Start up Summer 2013
- ~ 7 months

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The Solution

- Non-regenerative H_2S scavenger based sweetening system to treat: Produced Natural Gas; up to 23,300 Sm3/h (559 e3m3/d)
- Optimal or ideal Canwell Sweetening Package with a 120” Contactor

Main Challenges:

- Schedule!

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Process Conditions

Gas Flow Rate:	23,314 Sm^3/h (maximum)
	16,432 Sm^3/h (high)
	12,888 Sm^3/h (normal)
	9,584 Sm^3/h (turndown)
Gas pressure:	1096 kPag (159 psig)
Gas Temperature:	43 ^oC
Inlet H_2S Content:	3500 ppm (maximum)
Free liquids:	N/A
Outlet H_2S Content:	0 ppm

Proposed Chemical:	**Canwell 600SX**
Estimated Treating Rate:	8.3 mL/ppm $H_2S/e^3m^3/d$
Est. Daily Chemical Use:	16350 litres/day (+- 5%) maximum

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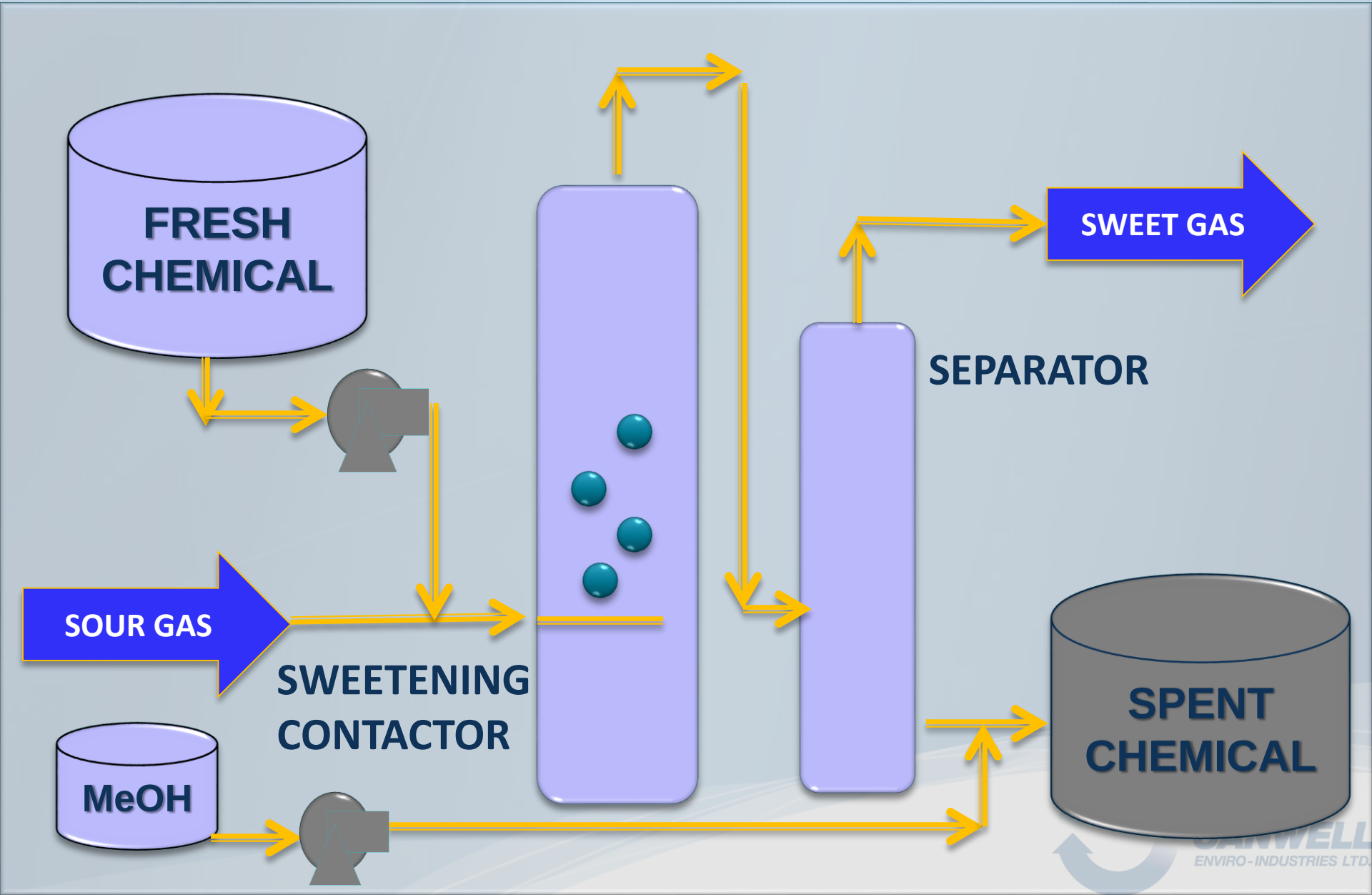
Flooded Tower System Overview



Sweetening System Options

- New Skid Package
- Retrofit of an existing skid package

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Options Advantages/Disadvantages

Advantages	Disadvantages
New Skid Package	
Fit for Purpose	Typical Lead time 9-18 months Consideration for onsite installation /startup commissioning
Client Specifications Met	Cost $1 – $2.5 million
New Equipment	Full EPCM Lifecycle
Retrofit of Existing Skid Package	
Accelerated schedule requirements met	Not fit for purpose. 120” Contactor is ideal
Lease option to client	Client specifications likely to be waived
Expedite EPCM Cycle	Recertification
Partial Engineering/Design	Rerating
Reuse of existing Equipment	

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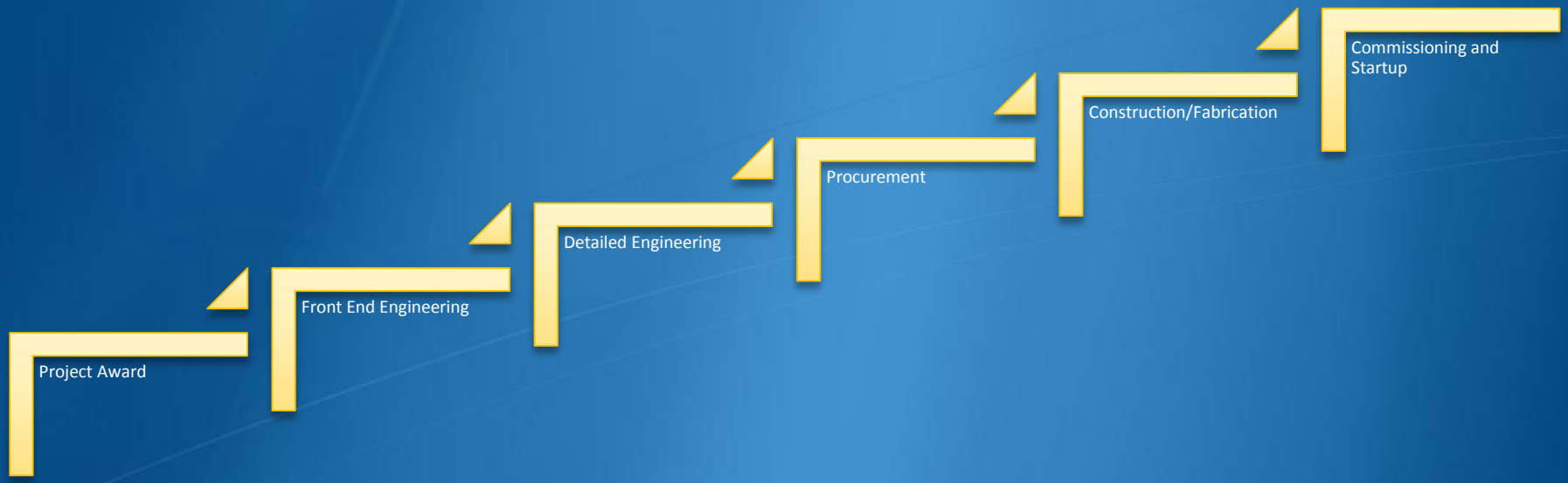
Full EPCM Lifecycle



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Full EPCM Lifecycle

- Delay in Client's requirements
- Not cost effective
- Retrofit Option pursued for advantages of condensing EPCM and working towards Client Schedule

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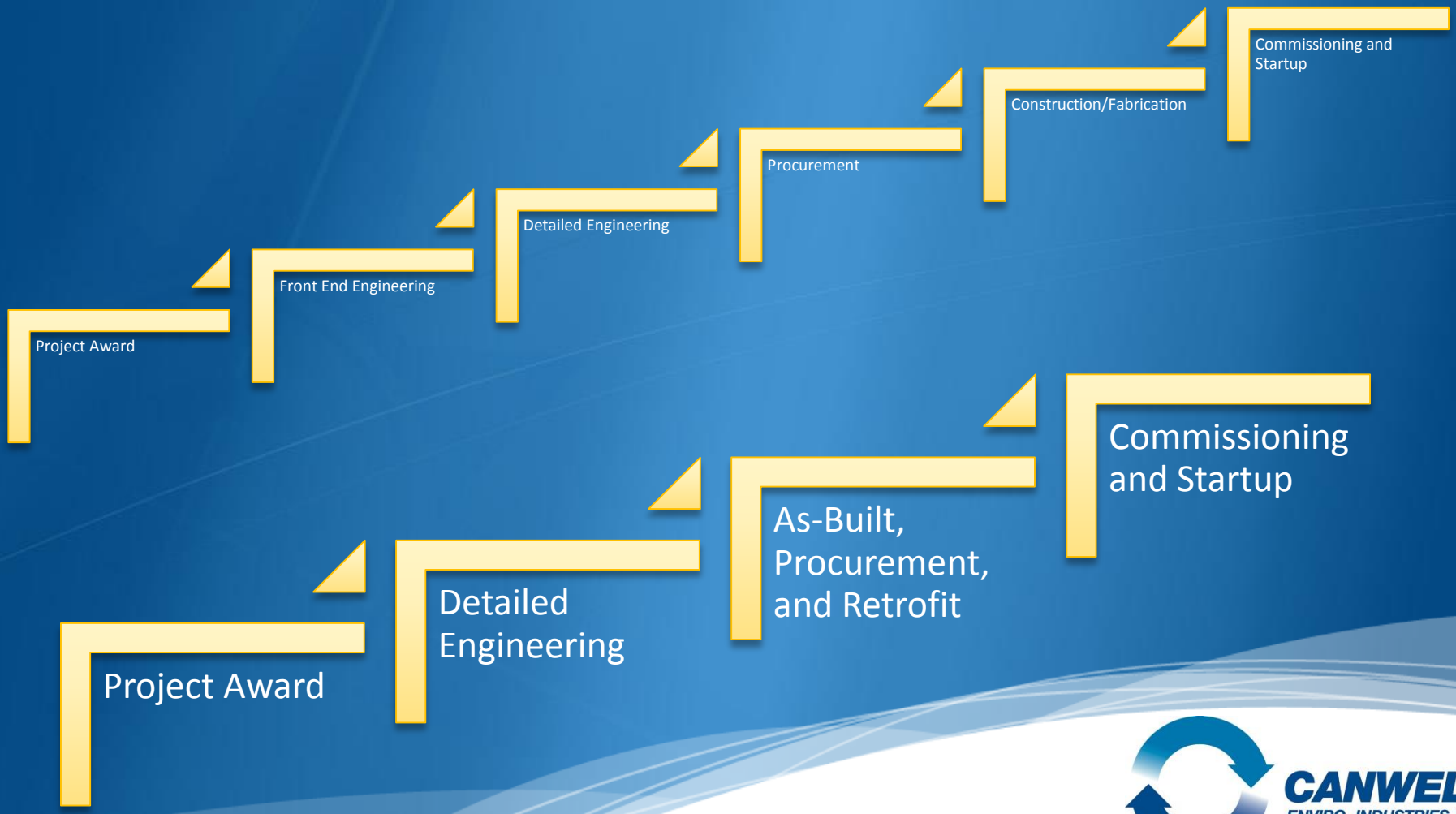
Full EPCM vs Condensed EPCM



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Retrofit Requirements

- Finding a close match to Process Requirements
- Site visits to confirm condition and extensive non-destructive testing and recertification
- Existing Documentation and As-Builting?
- Verification of existing Process/Mechanical/Electrical/Instrumentation

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Integrity and Inspection

- Condition of Project Award
- Rerating of Vessels

Excavated indication on Bottom head to shell weld @ 1 o'clock

Excavated indication on Bottom head to shell weld @ 12 o'clock

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Existing and New Mechanical, Electrical, Instrumentation

- Fugitive Emissions Study
- Replaced all electrical to match classification requirements

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Existing and New Mechanical, Electrical, Instrumentation

- Control System
- Replaced Pumps
- Replaced and revised instrumentation, provided engineering for automatic pump control
- Provided dual stream H_2S analyzer to manage chemical optimization

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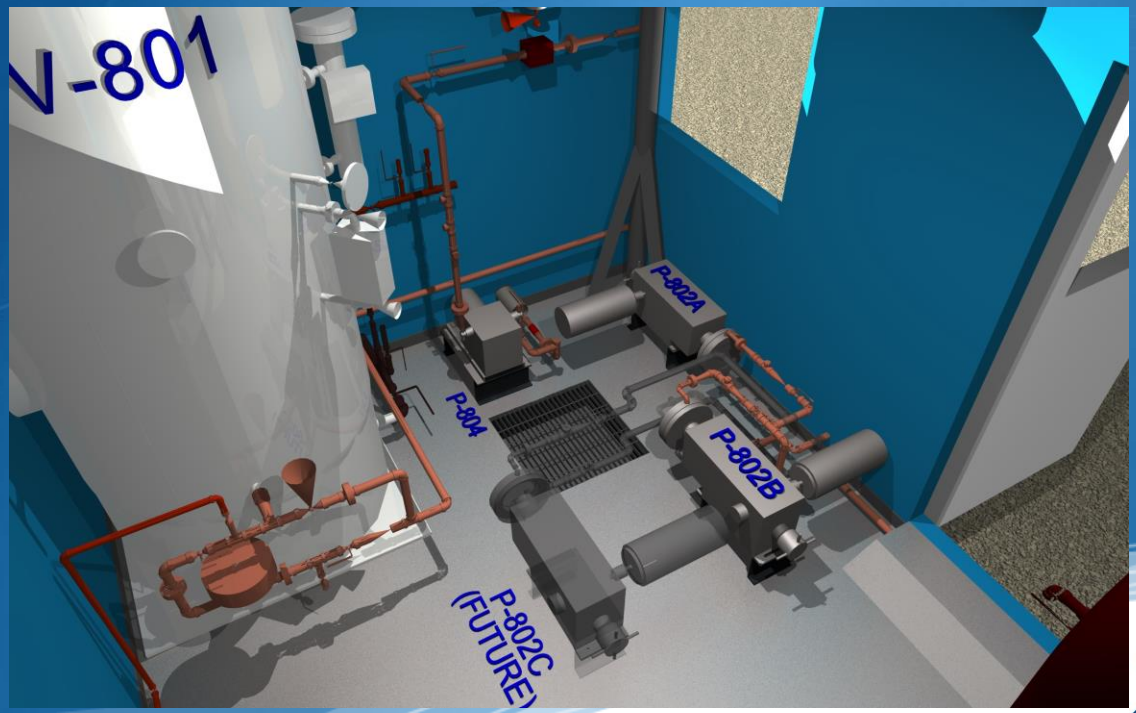
Adjustable Stroke Length Pump

Required Flow (L/d)	Pump On	Pump Off
0-5544	P-802B	P-802A, P-802C
5544-11088	P-802B and P-802A or P-802C	P-802A or P-802C
11088-16632	P-802B, P-802A, P-802C	N/A



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Decommissioned Scavenger System

- This system includes
  - Scavenger chemical injection
    - Three injection pumps rated at 5500 L/d per pump
  - 96” flooded sweetening tower
    - Design pressure 670 psig
    - Packed bed
  - 48”post separator
    - Design pressure 670 psig
    - Automatic dump valve
  - Methanol injection
    - Injection pump rated at 606 L/d

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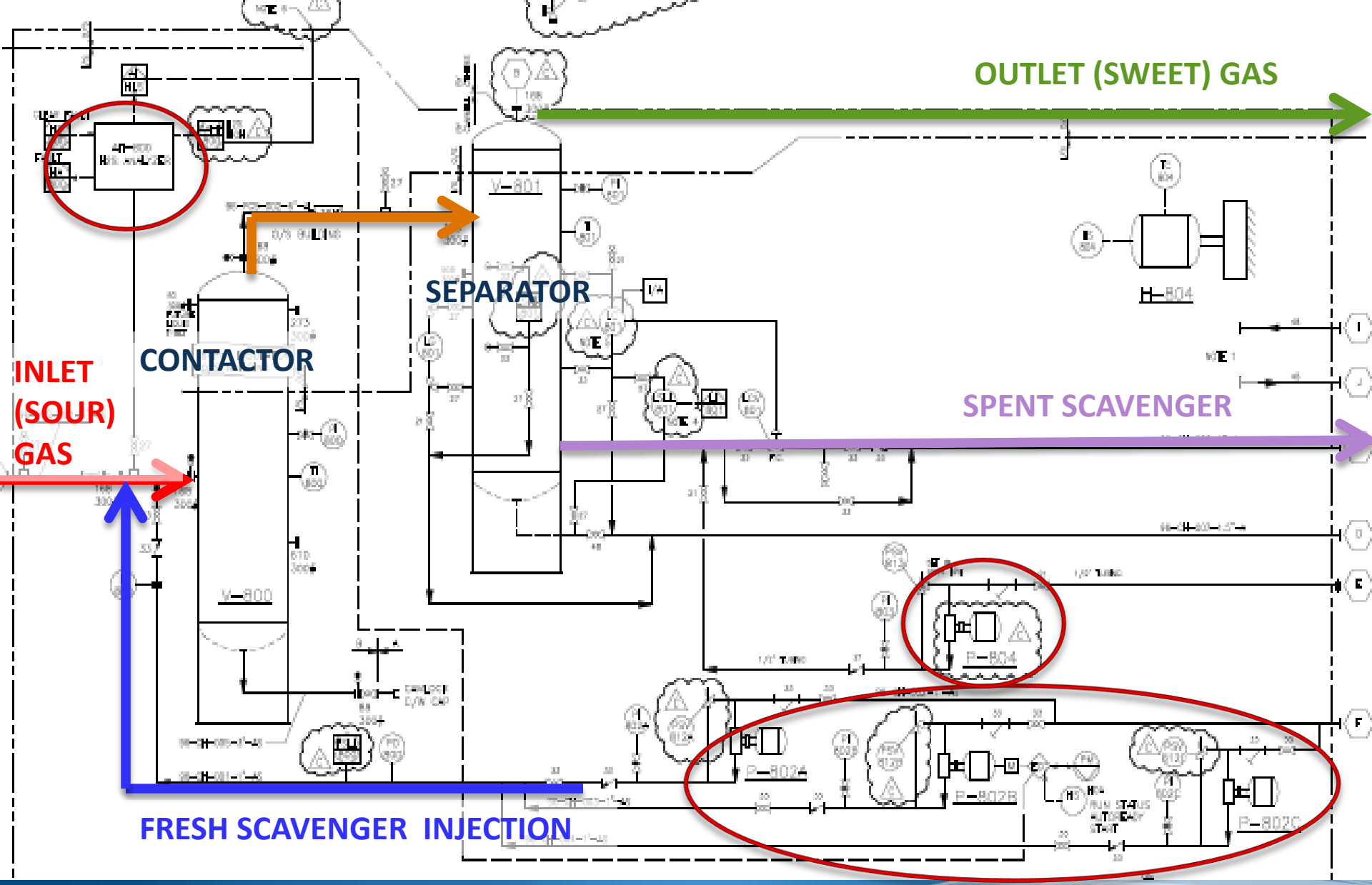

System Overview

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Flooded Tower System Overview

- Sour gas enters the contactor tower (V-800)
- Fresh scavenger is pumped from the fresh chemical storage tank upstream of the contactor by the chemical pumps (P-802A/B/C).
- The sweetened gas and entrained spent liquid flows out of the contactor to the separator (V-801).
- The spent chemical automatically dumps from the separator to the spent chemical tank.
- Methanol is pumped from the methanol storage tank by the methanol injection pump (P-804)

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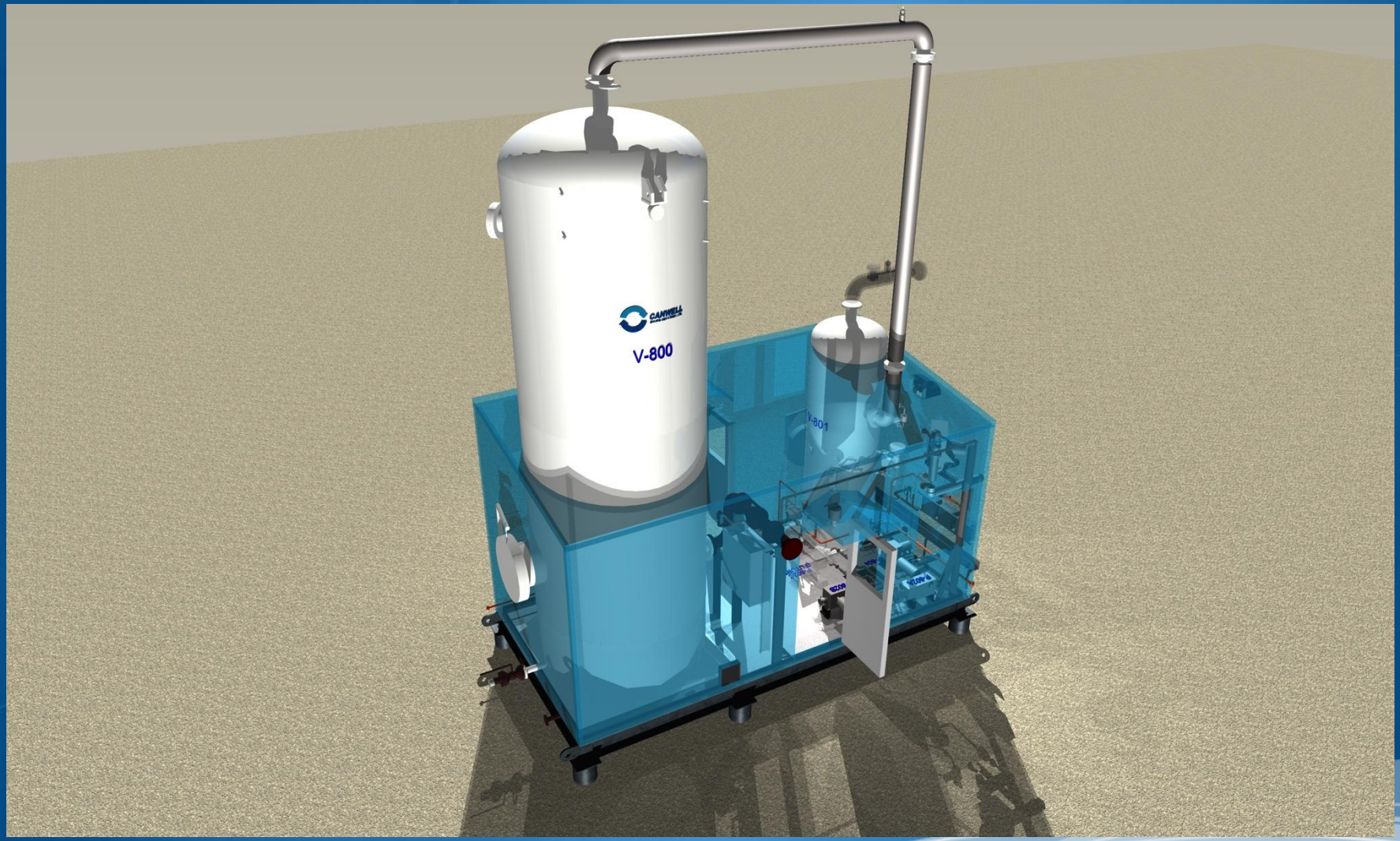
3D Model - Skid Overview



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3D Model - Skid Profile

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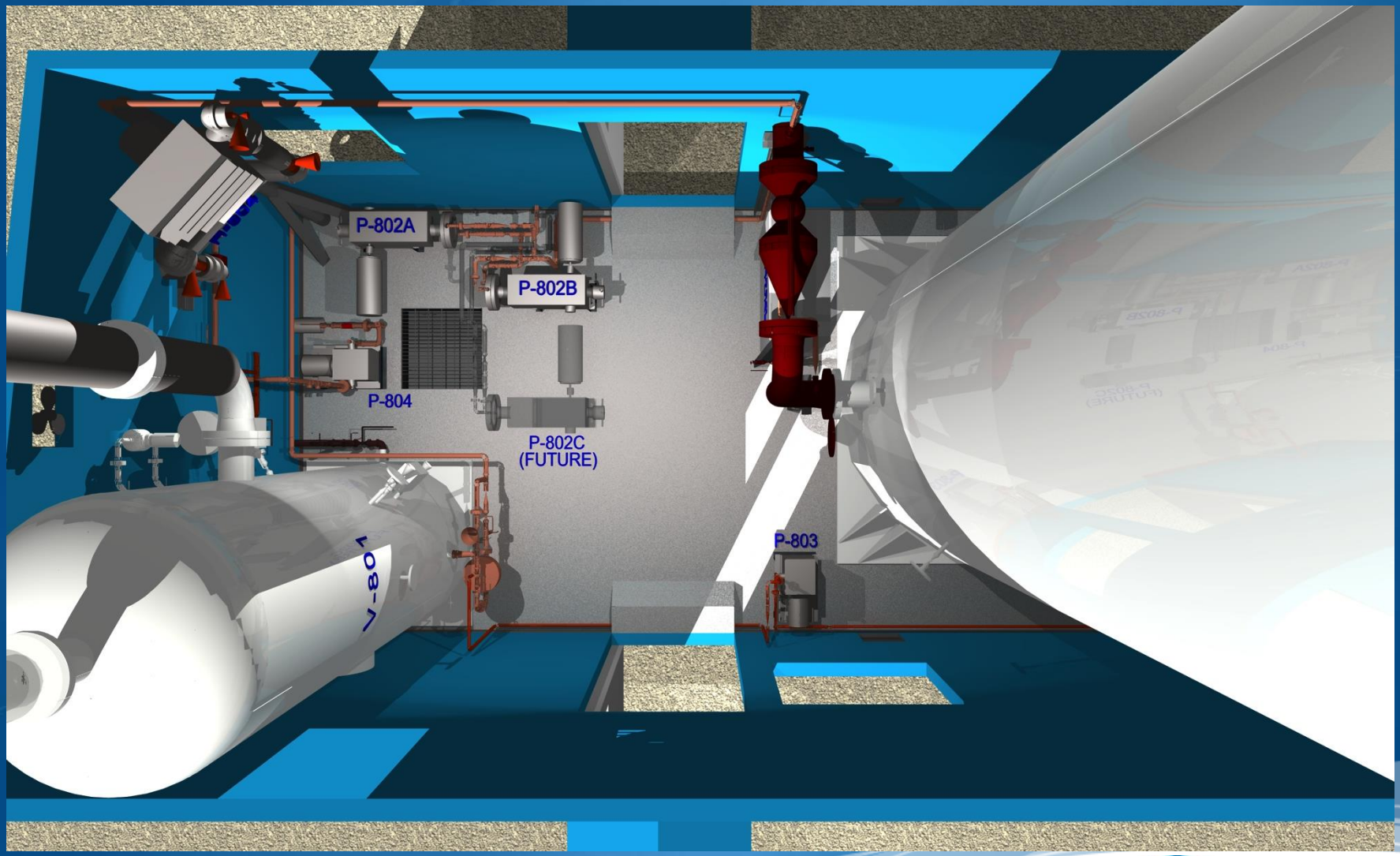
3D Model - Internal Top View



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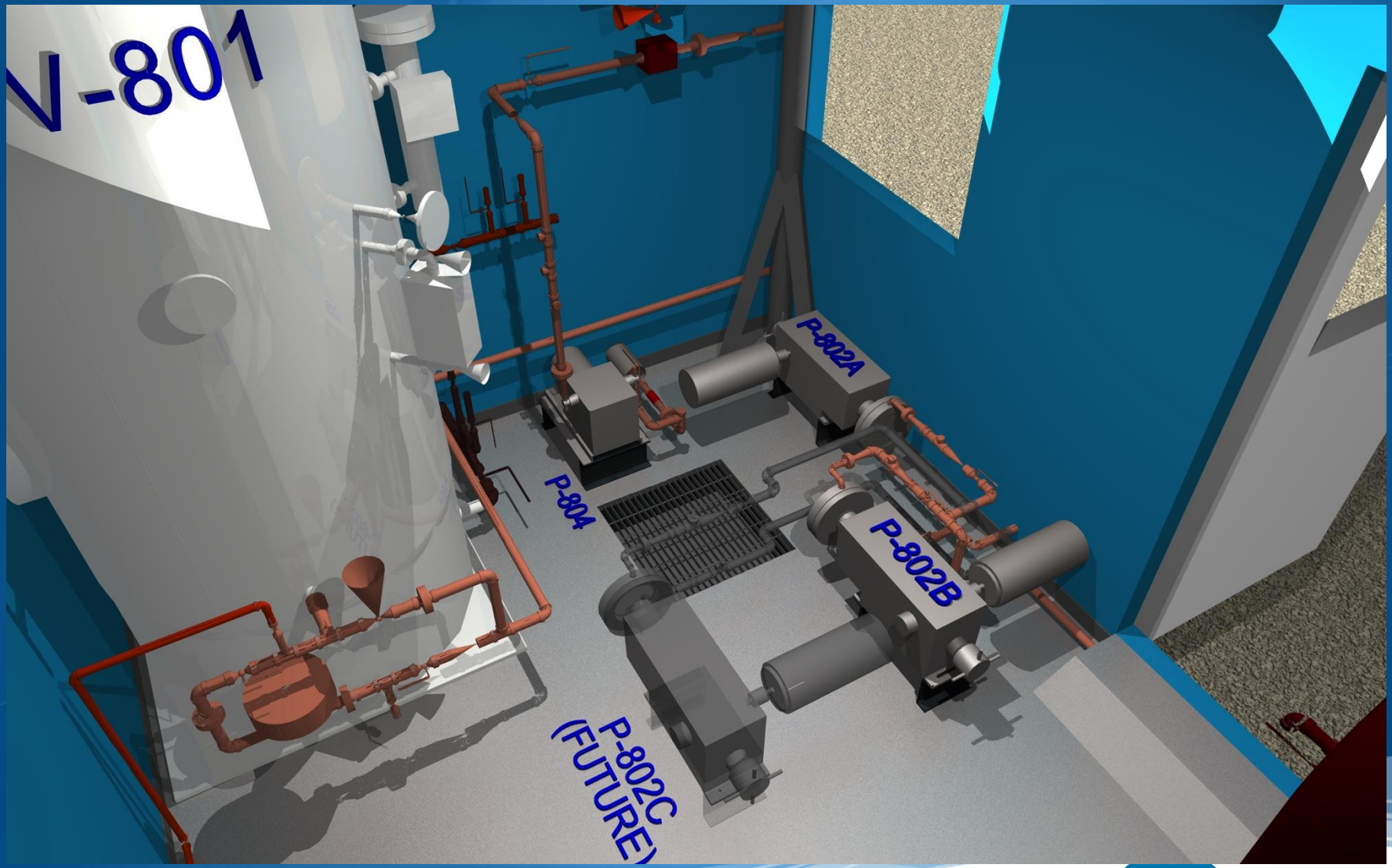
3D Model - Pump Locations



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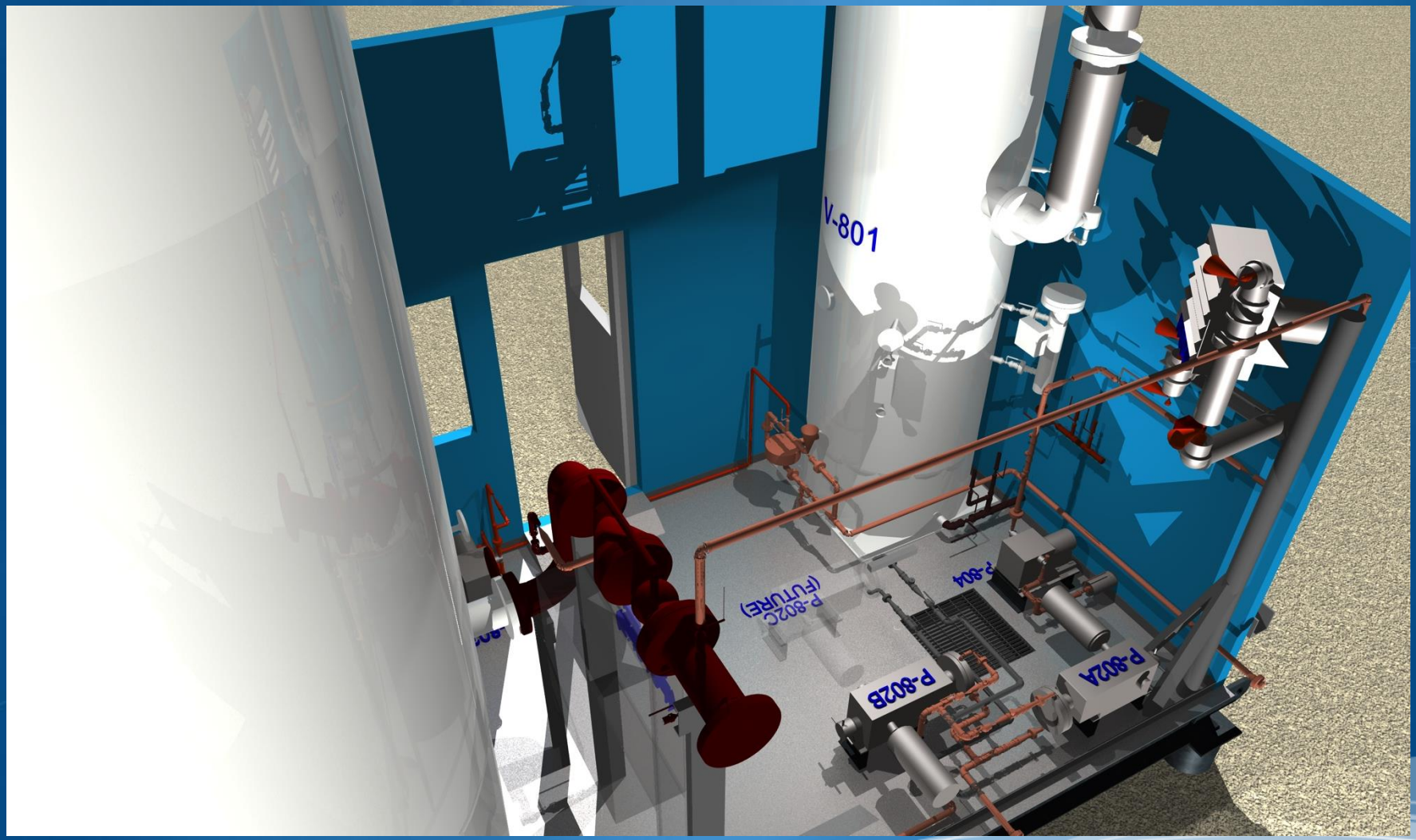
3D Model - Separator



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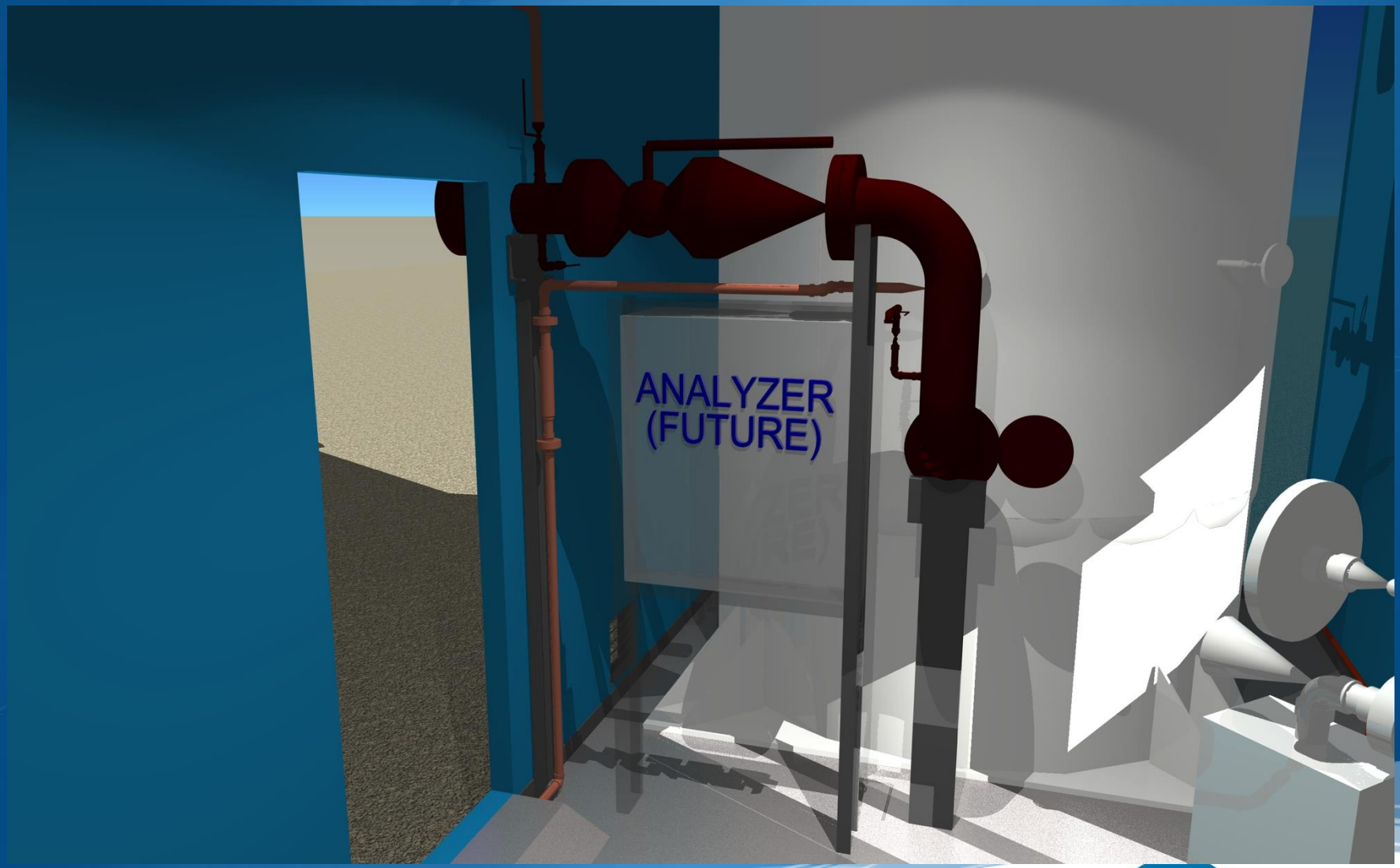
3D Model - H2S Analyzer Location



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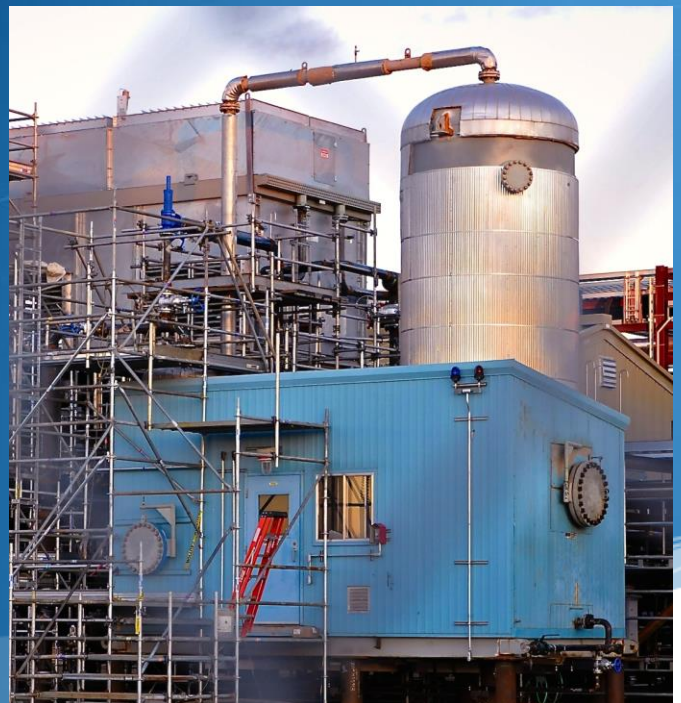
Logistics and Commissioning

- Canwell supported the client for all logistics and transportation from the existing location to their site.
- Canwell also provided on-site operator training, on-site construction support for tie-ins, piping, and as-builting once installed at site.



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Logistics and Commissioning

- The Operations and Maintenance Manual included the as-builting and included all loading and handling of the chemistry.
- Canwell provided pre-commissioning support, commissioning support, and on-going operational support and system optimization in order to ensure a smooth transition from delivery to installation and to ensure package was being installed in accordance with the Operations and Maintenance manual.

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Operations Manual & Training

- HSE Procedures
- Chemical Handling
- Flow Rate, Pressure and Velocity

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HSE Procedures - General

- Key HSE points:
- Fresh and spent chemical do not contain H2S
  - Sulphur is chemically changed in the spent chemical and off-gassing of H2S is not a concern
- Similar handling protocol to other oilfield chemicals
  - avoid skin contact and flush if required
  - avoid unnecessary or prolonged inhalation of vapours and ensure good ventilation
  - further details in following slides, O&M manual and MSDS

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Chemical Handling

Loading and Unloading:

- Chemical loading and unloading is conducted by Canwell and our contract transport company Legend Trucking
  - Fresh chemical is delivered and spent chemical removed by the same truck
  - Spent chemical is loaded and transported to approved Class 1A/1B downhole disposal facility
  - Spent chemical is generally injected immediately or may be stored temporarily in onsite tanks at the disposal facility

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Flow Rate, Pressure and Velocity

- Flowrates (and associated operating pressures) dictate vessel size based on gas ***velocity*** and ***contact time***
- Varying flowrates will affect residence/contact time
- Higher pressure therefore allows smaller vessel size
- Goal is to achieve a flow velocity of 0.05 to 0.24 m/s (0.15 to 0.8 ft/s)
- Optimal is approx. 0.12 m/s (0.4 ft/s)

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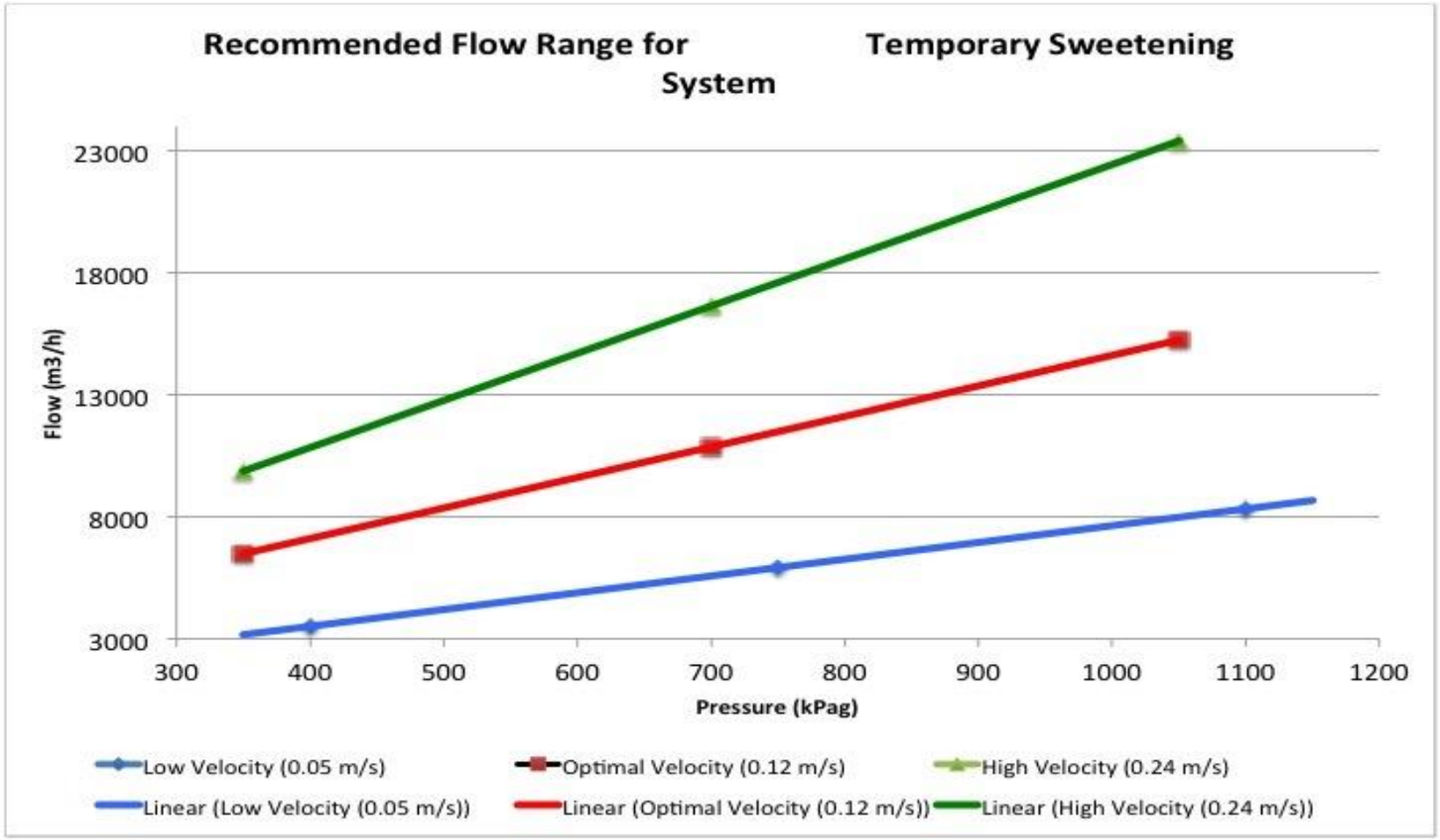

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Canwell Flooded tower process (600 SX)
Injection Rate in Liters per day

H2S	ppm	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500
Gas Flow	4000.0	1128	1354	1580	1805	2031	2257	2482	2708	2934	3159
Sm3/h	5000.0	1410	1692	1975	2257	2539	2821	3103	3385	3667	3949
	6000.0	1692	2031	2369	2708	3046	3385	3723	4062	4400	4739
	7000.0	1975	2369	2764	3159	3554	3949	4344	4739	5134	5529
	8000.0	2257	2708	3159	3611	4062	4513	4965	5416	5867	6319
	9000.0	2539	3046	3554	4062	4570	5077	5585	6093	6601	7108
	10000.0	2821	3385	3949	4513	5077	5642	6206	6770	7334	7898
	11000.0	3103	3723	4344	4965	5585	6206	6826	7447	8067	8688
	12000.0	3385	4062	4739	5416	6093	6770	7447	8124	8801	9478
	13000.0	3667	4400	5134	5867	6601	7334	8067	8801	9534	10268
	14000.0	3949	4739	5529	6319	7108	7898	8688	9478	10268	11057
	15000.0	4231	5077	5924	6770	7616	8462	9309	10155	11001	11847
	16000.0	4513	5416	6319	7221	8124	9026	9929	10832	11734	12637
	17000.0	4795	5754	6713	7672	8632	9591	10550	11509	12468	13427
	18000.0	5077	6093	7108	8124	9139	10155	11170	12186	13201	14217
	19000.0	5359	6431	7503	8575	9647	10719	11791	12863	13935	15006
	20000.0	5642	6770	7898	9026	10155	11283	12411	13540	14668	15796
	21000.0	5924	7108	8293	9478	10662	11847	13032	14217	15401	16586
	22000.0	6206	7447	8688	9929	11170	12411	13652	14894	16135	17376
	23000.0	6488	7785	9083	10380	11678	12975	14273	15571	16868	18166

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Final Schedule

- Client approached Canwell January 2013
- Integrity and Inspection
- Project Award – May 9th 2013
- Mechanical Completion August 7, 2013
- Commissioning - Sept 26, 2013
- Startup - Nov 8, 2013

From Project Award
to Startup:
6 months!

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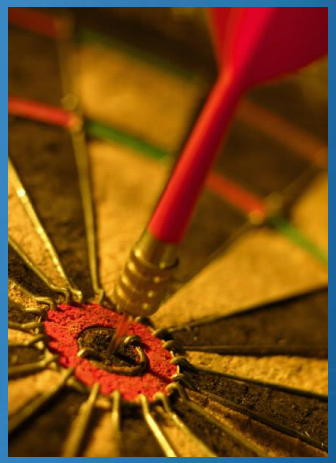
EPCM Condensed Benefits to Client

- Shorter Schedule
- Quick Equipment Delivery
- Sound Operational solution
- O&M Manual
- Logistics, Commissioning, and Operator Training



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Cost of EPCM Condensed

Item	Cost	Notes
1 year rental cost	$432,000.00	12 month rental cost
Canwell PM, Engineering, and Inspection costs	$146, 500.00	Inclusive in monthly rental costs over 1 year
In skid Mechanical/Instrument modifications	$85, 000.00	Inclusive in monthly rental costs over 1 year
3rd party Dismantling, Cleaning, Inspection and packaging for shipment	$162,000.00	Billed directly to client
Onsite Support	$32, 000.00	Inclusive in Chemical supply
Total cost to Client	**$594,000.00**	**Inclusive of 1 year rental and direct costs**

Note – Client direct labor and site installation costs are not summarized above. Fresh and spent tanks not considered. Chemical usage costs while in service are extra.

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