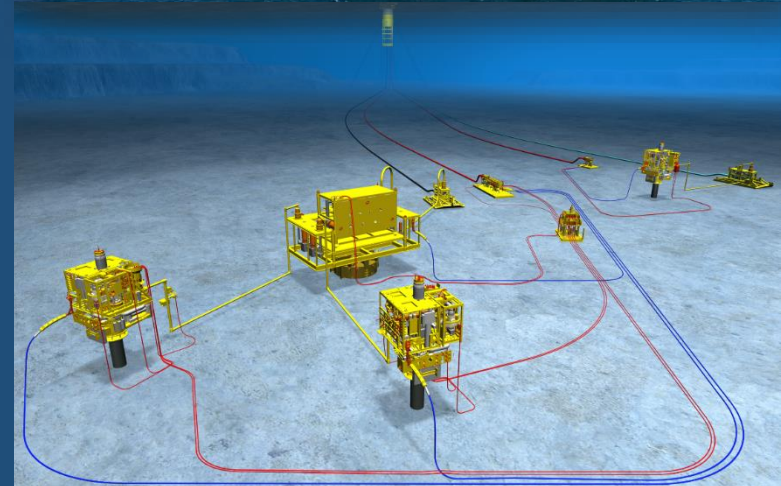




Oil and Gas
**Subsea Chemical
Storage and Injection**

SCIU System

HAMMELMANN®

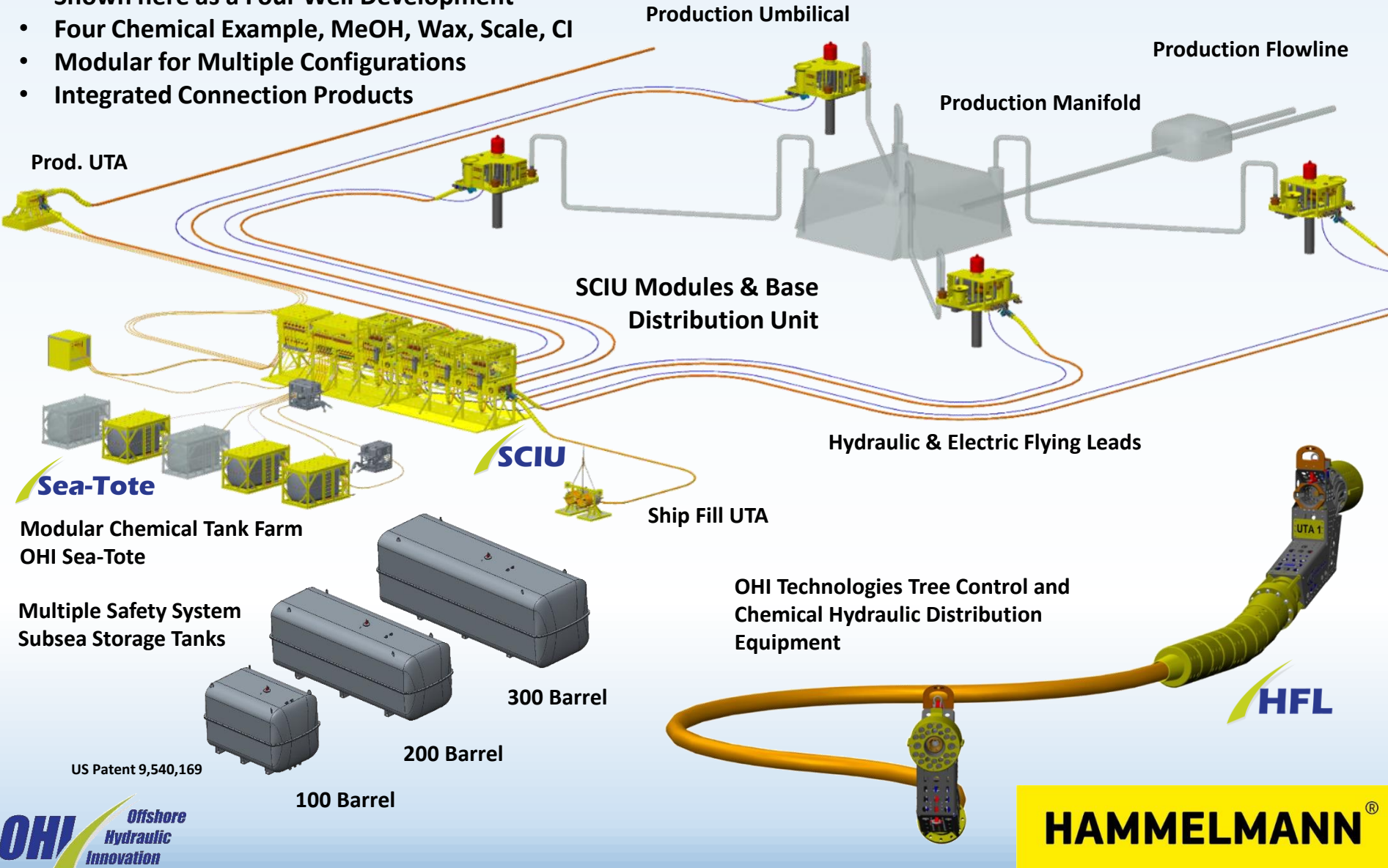


Subsea Chemical Injection - SCIU

Subsea Chemical Storage and Injection

OHI Chemical Delivery System

- Shown here as a Four Well Development
- Four Chemical Example, MeOH, Wax, Scale, Cl
- Modular for Multiple Configurations
- Integrated Connection Products



Prod. UTA

Production Umbilical

Production Flowline

Production Manifold

SCIU Modules & Base
Distribution Unit

Hydraulic & Electric Flying Leads

Sea-Tote

SCIU

Ship Fill UTA

Modular Chemical Tank Farm
OHI Sea-Tote

Multiple Safety System
Subsea Storage Tanks

OHI Technologies Tree Control and
Chemical Hydraulic Distribution
Equipment

300 Barrel

200 Barrel

100 Barrel

US Patent 9,540,169

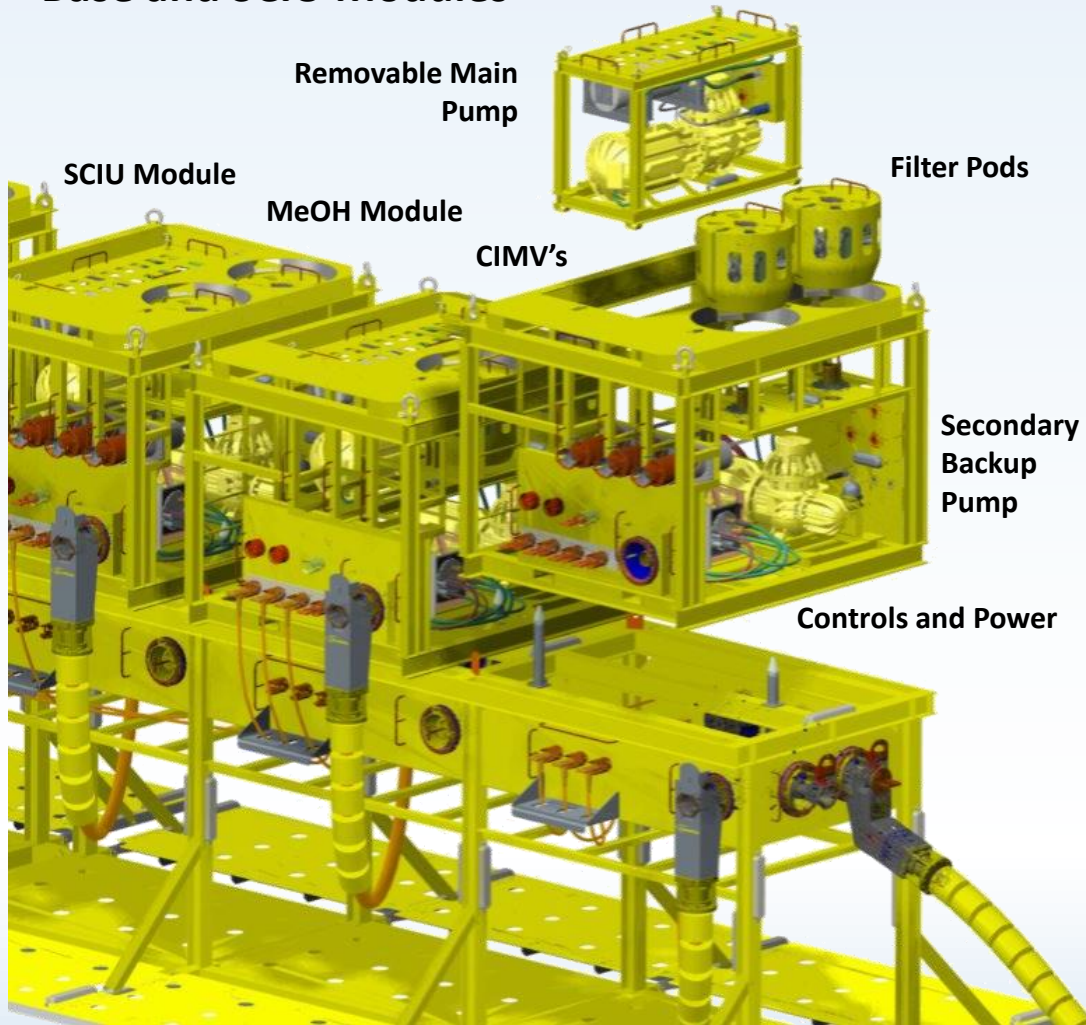
HFL

HAMMELMANN®

OHI Offshore
Hydraulic
Innovation

Subsea Chemical Injection Unit - SCIU

Base and SCIU Modules



SCIU Base Module

System Overview – SCIU Module Features

SCIU Base Module

- One Control Can and one Power Can
- Power A&B inputs with auto-switchover
- Control A&B inputs with auto-switchover
- Integrated Reserve Battery System
- Includes Backup Pump
- Three CIMV for up to 6 Injection Points
- May be ROV replaced for minimal Maintenance

Removable Main Pump Pod

- Integrated Motor Controller/Soft start
- Sub-Module Removable Main Pump
- Newly serviced pump can be deployed while backup pump operates. No production downtime

Removable Filter Pods

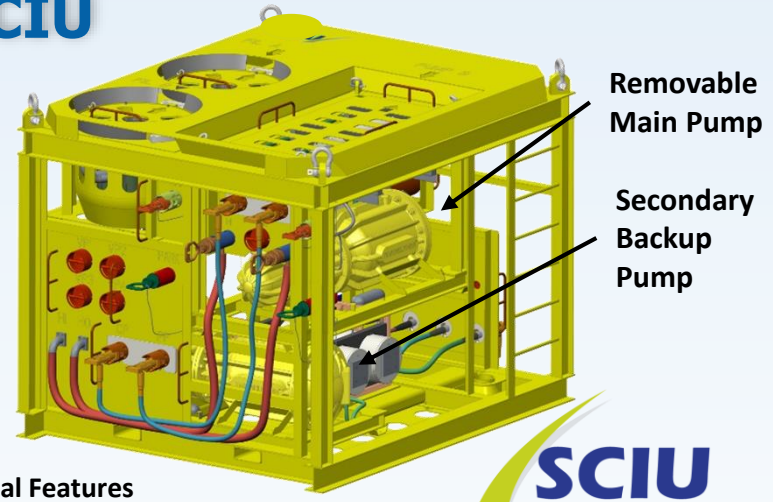
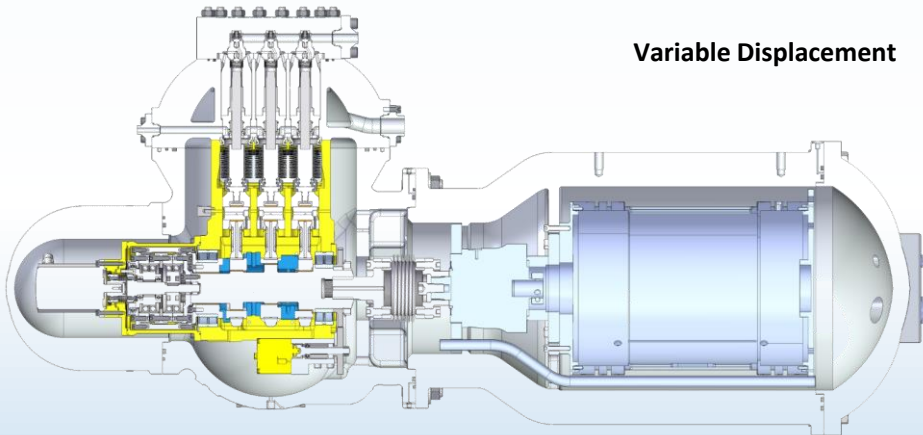
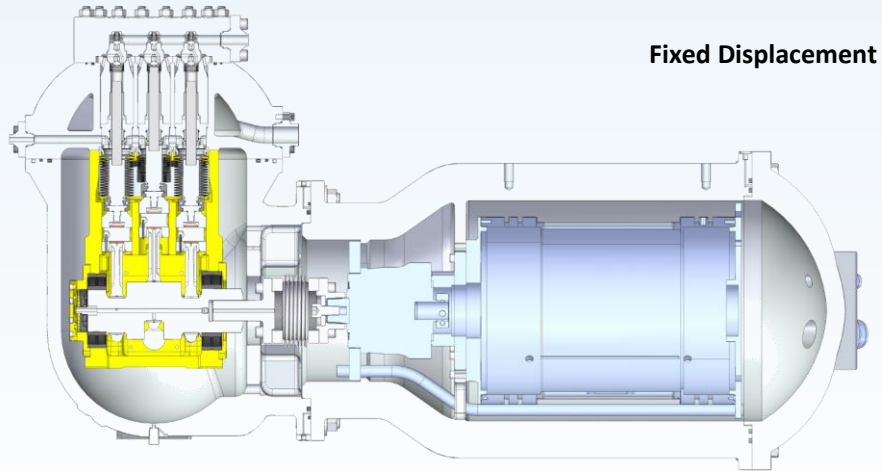
- Filter elements ROV removable

Module Dimensions (all approx.)	Weight in Air	Weight in Sea Water
9' x 9' x 8.5'	19,000 lbs	17,000 lbs
3.2 x 3.2 x 2.8 m	8,620 kg	7,700 kg

Subsea Chemical Injection Unit - SCIU

Subsea Pump

70Hp and 20Hp Long Endurance Fixed and Variable Displacement Chemical Pump



Critical Features

- Hammelmann® Pump able to pump methanol, LDHI, and well treatment chemicals, up to 20Kpsi
- Designed for Long Duration Subsea Use
- Compatible in manifold systems and Chemical Distribution Valve Systems CIMV
- Packaged for Modular Removal and Maintenance
- Fixed and Variable Displacement

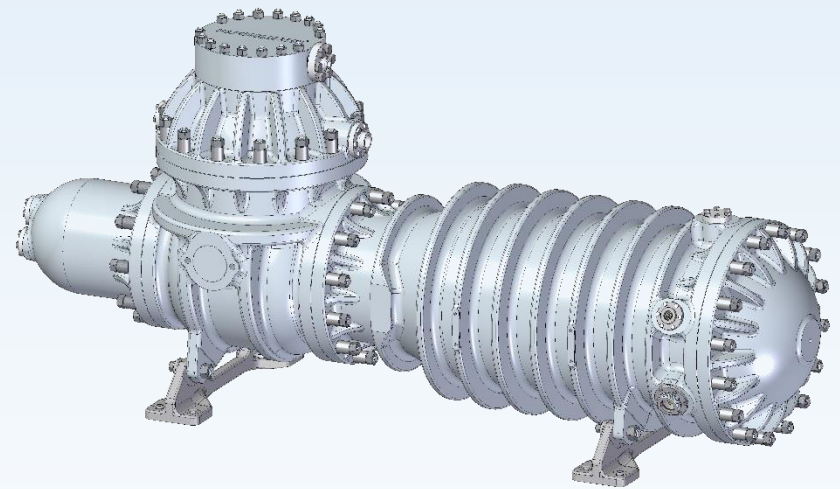
20 HP Pump (15KW Motor)					70 HP Pump (55KW Motor)				
Output Pressure		Plunger Size	Discharge		Output Pressure		Plunger Size	Discharge	
PSI	Bar		GPM	LPM	PSI	Bar		GPM	LPM
3000	207	25.0	6.6	25.0	3000	207	40.0	24.0	91.0
5000	345	20.0	4.2	16.0	5000	345	35.0	18.2	69.0
7500	517	17.5	3.2	12.0	7500	517	30.0	13.2	50.0
10000	689	15.0	2.4	9.0	10000	689	26.0	10.0	38.0
15000	1034	12.0	1.5	5.7	15000	1034	22.0	6.9	26.0
17500	1207	10.0	1.0	3.6	17500	1207	20.0	5.5	21.0
20000	1379	10.0	1.0	3.6	20000	1379	17.5	4.5	17.0

Subsea Chemical Injection Pump

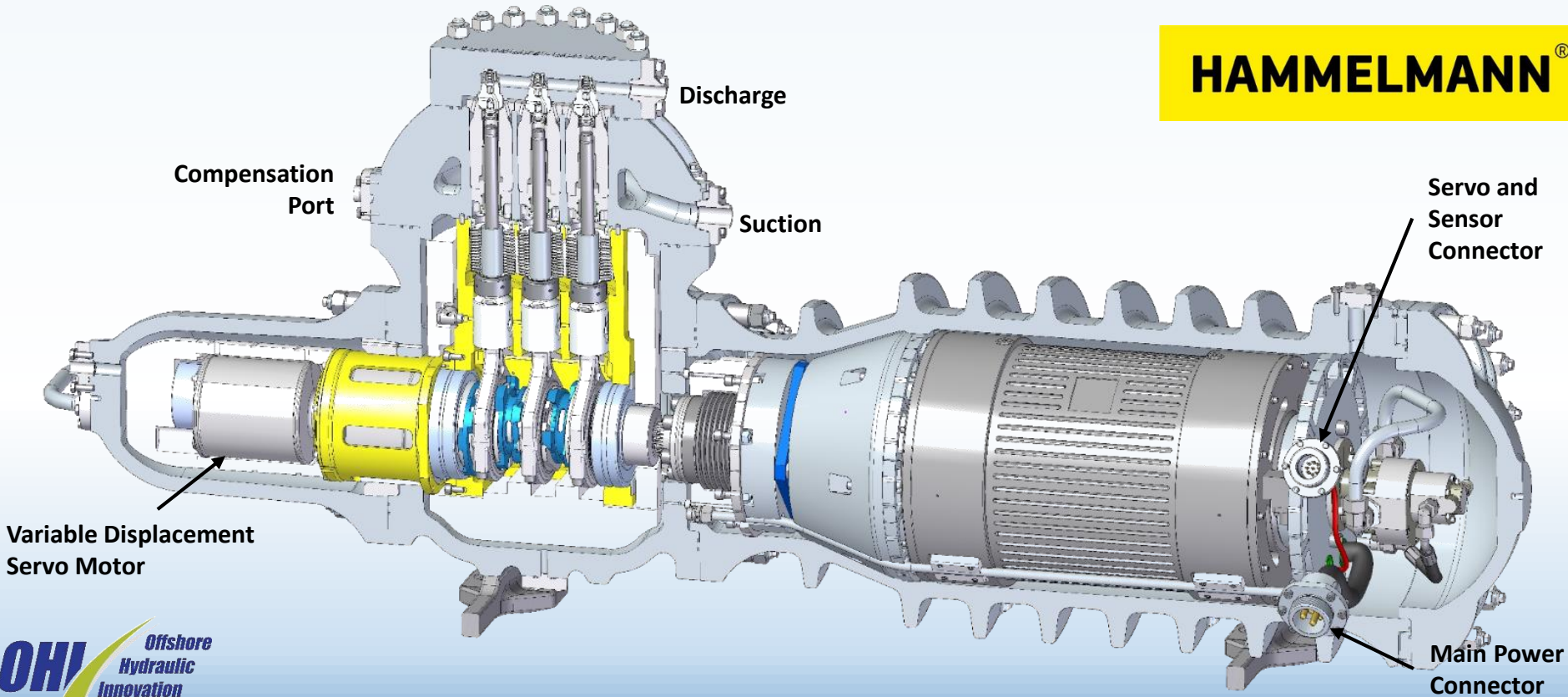
Closer Look at the 70 Hp Variable Displacement Pump

General Specifications

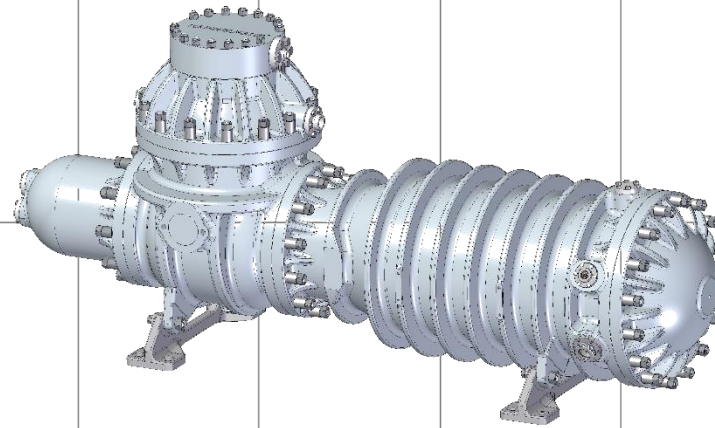
- 30,000 Hour Pump Design, for use with most all subsea injection chemicals, full time or intermittent use.
- Shared volume of pump and electric motor oil, fully compensated to ambient surroundings, Oil is Mobil SHC 624 series oil (ISO viscosity grade 32). Nominal operating Temp is 50°C (122°F) max 65°C (150°F)
- Overall: Height 1.04m (41"), Length 2.56m (101"), Width .65m (25.6")
- Weight is Appx. 2300Kg (5000lb) with AC motor.



HAMMELMANN[®]

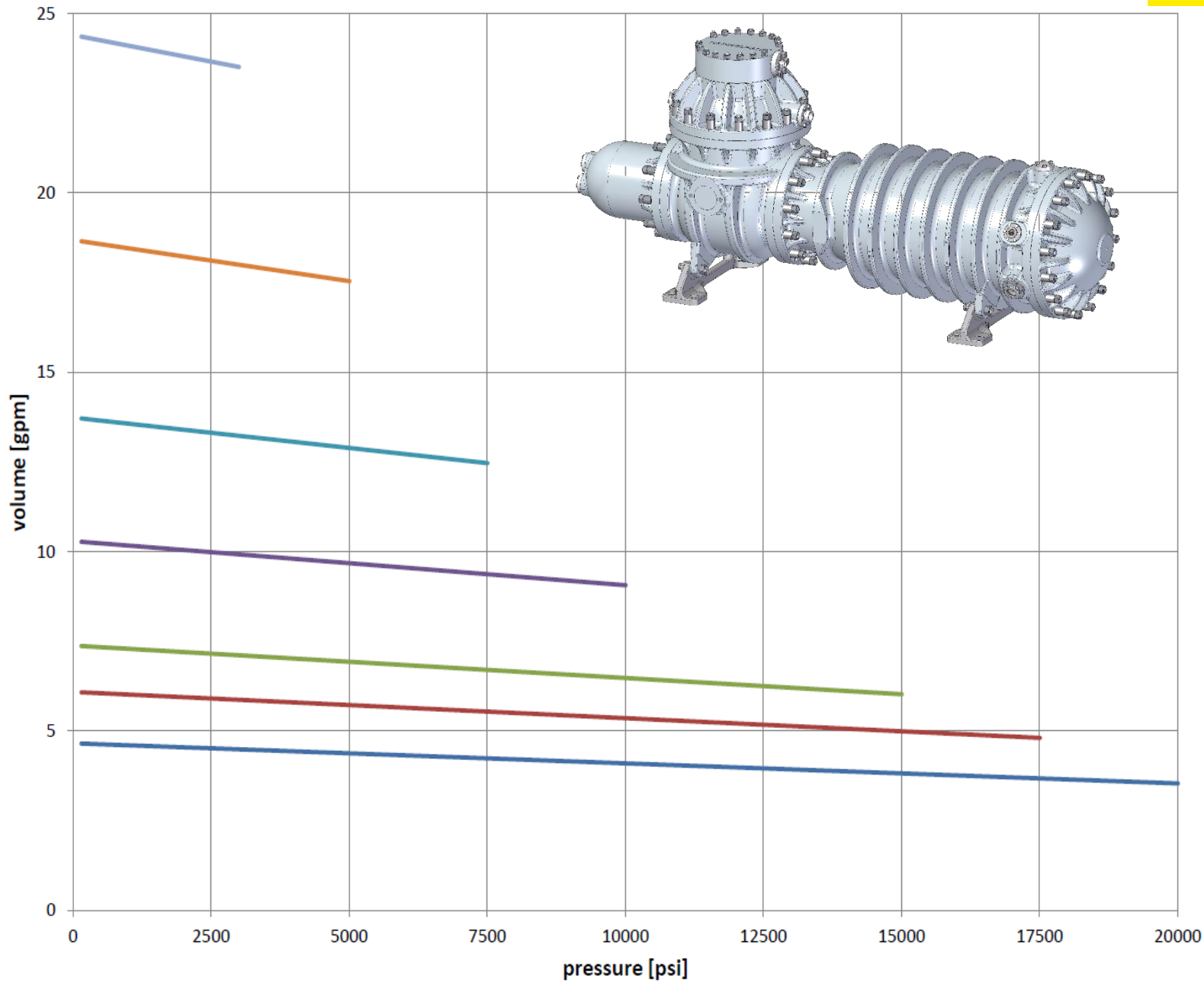


**Subsea Pump
Performance
GPM vs Pressure**



**Multiple Piston
Configurations**

- piston dia 17,5 mm
- piston dia 20 mm
- piston dia 22 mm
- piston dia 26 mm
- piston dia 30 mm
- piston dia 35 mm
- piston dia 40 mm



Subsea Chemical Injection Unit – Single Intervention Unit

Hybrid Stand Alone SCIU & Tank

Adaptations and Configurations – SCIU Modularity

Scale Injection

Dosing Chemicals, Wax, CI, PP, LDHI

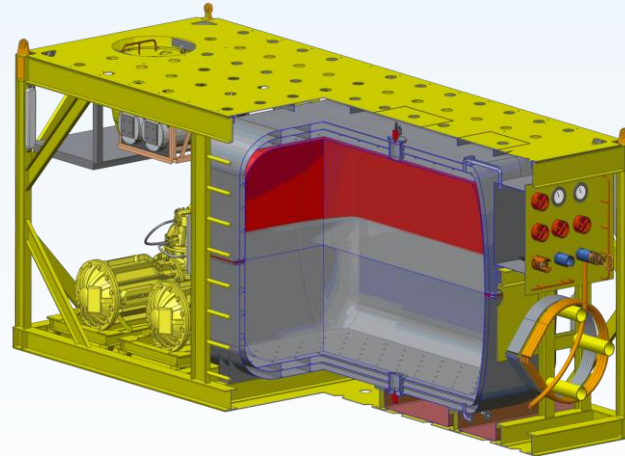
Biocide Injection

MEG Module

MeOH Module

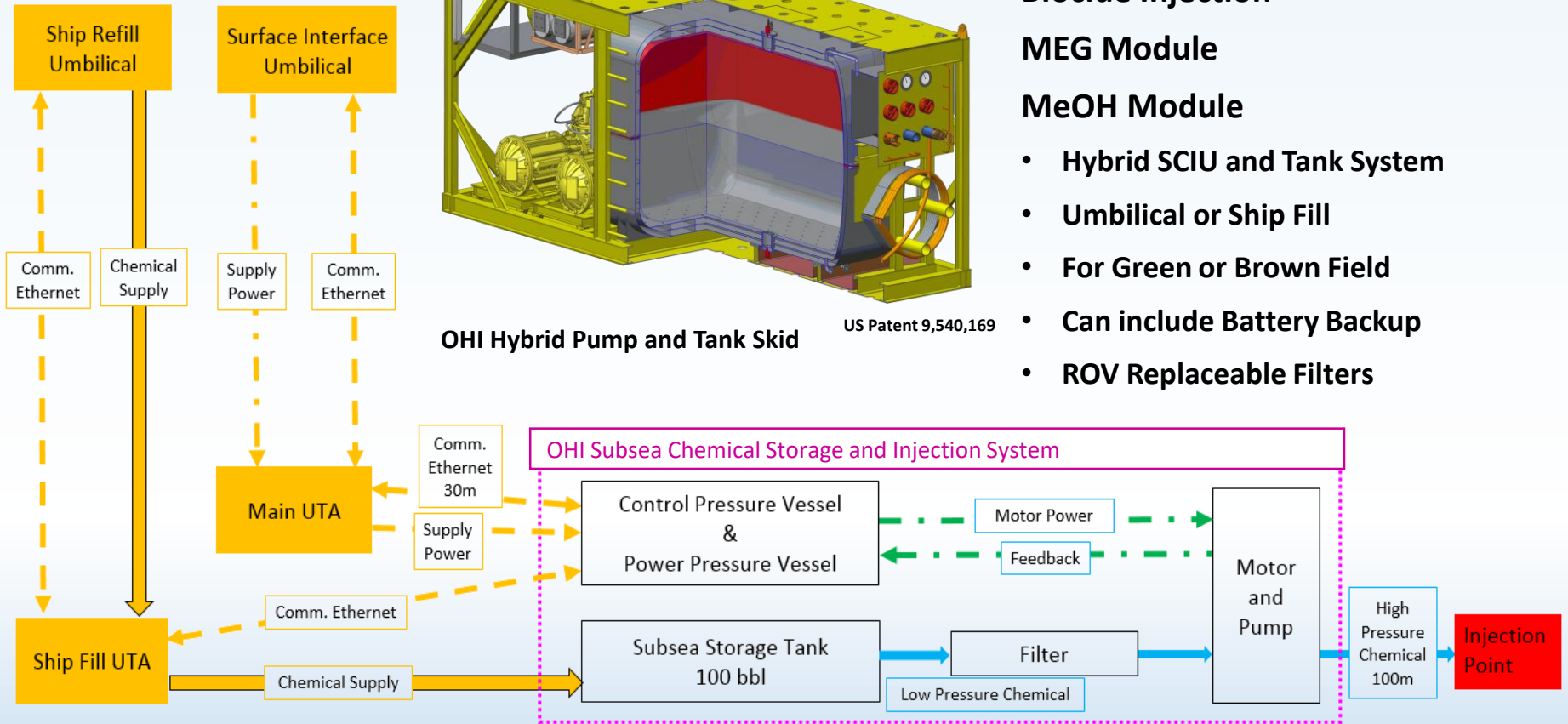
- Hybrid SCIU and Tank System
- Umbilical or Ship Fill
- For Green or Brown Field
- Can include Battery Backup
- ROV Replaceable Filters

ROV Replaceable Filters



US Patent 9,540,169

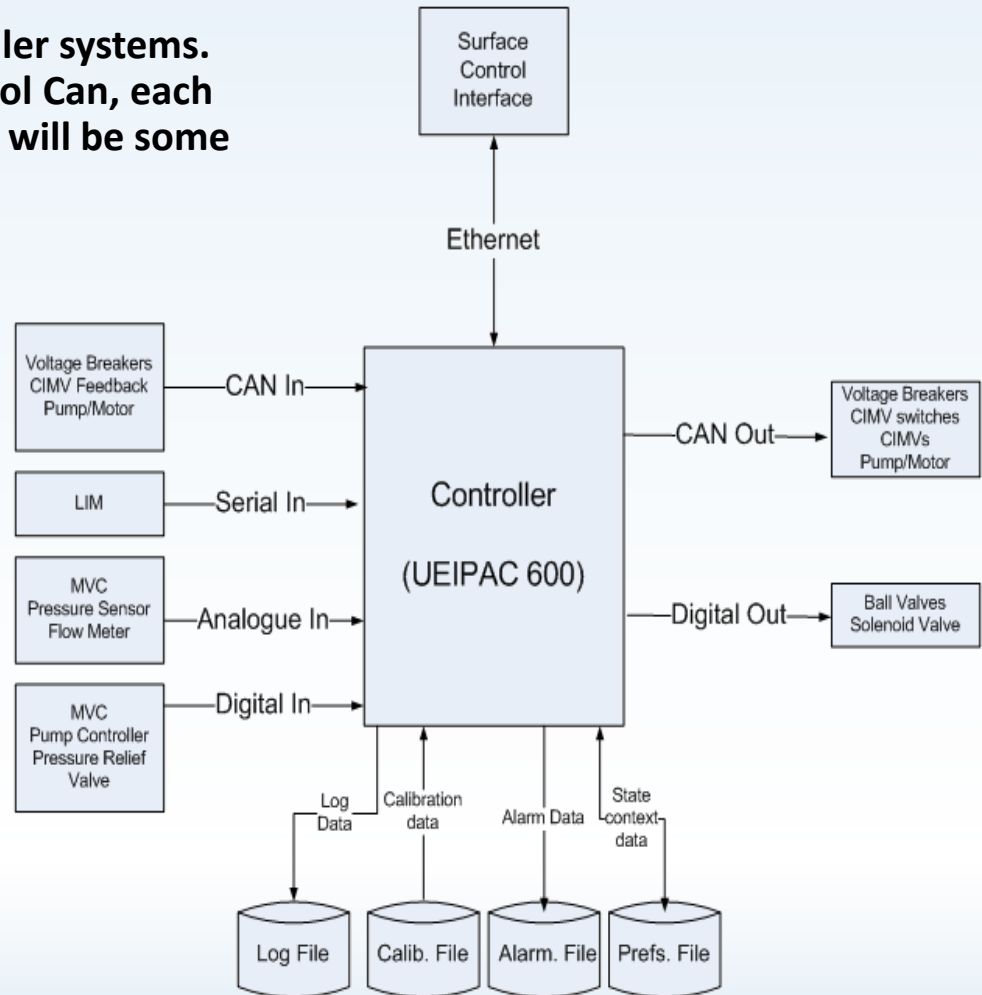
OHI Hybrid Pump and Tank Skid



Subsea Chemical Injection Unit – SCIU Control

Control software is broken in to multiple controller systems. A Master Control Can, Methanol and SCIU Control Can, each have a local CPU. The requirements of each CPU will be some or all of the following.

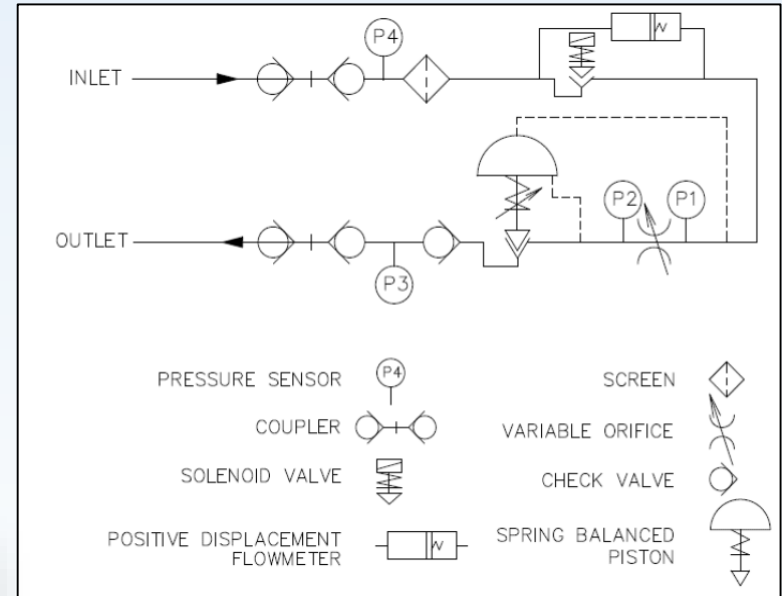
- Receive TCP/IP Ethernet commands from the surface.
- Control individual breaker circuits and receive feedback.
- Interface with the Line Insulation Monitor.
- Receive feedback from MVCs.
- Read all pressure sensors and flow meters.
- Control all ball valve mechanisms.
- Control and monitor CIMV switches and CIMVs.
- Interface with pump controllers and soft starters.
- Package data from all the above items into UDP frames transmit through Ethernet to the surface.



Subsea Chemical Injection - Metering

Chemical Injection Metering Valves CIMV

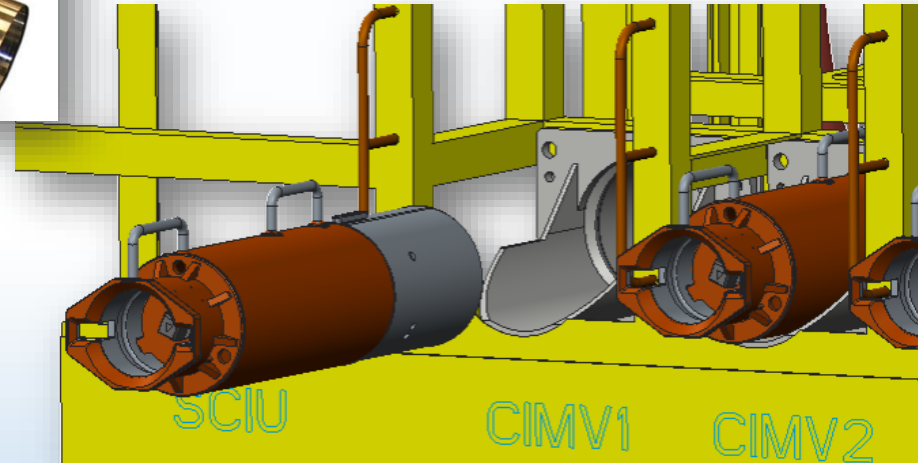
- Can be provided with specific features from multiple manufacturers, SkoFlo®, Cameron®, Hunting®, or other.
- Able to Meter Chemicals independent of Downstream Pressure Changes
- May be Mounted in the SCIU, Tree, or other
- Can be ROV Independently Removable or Fixed to the SCIU



Example CIMV Schematic, Courtesy SkoFlo® Industries



Example of CIMV, Courtesy Cameron®, and SkoFlo® Industries



Example CIMV Mounted in SCIU along with Pumps and Controls

Subsea Chemical Injection Unit - Filters

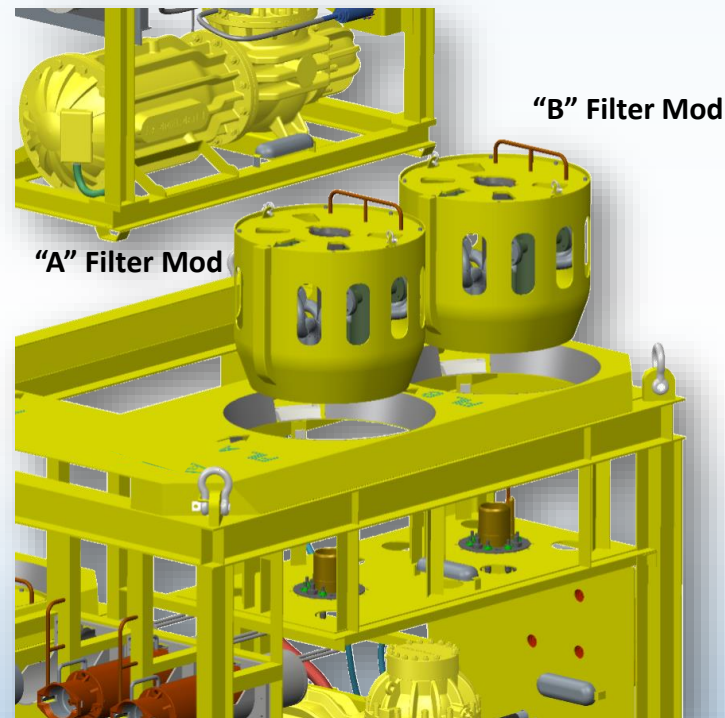
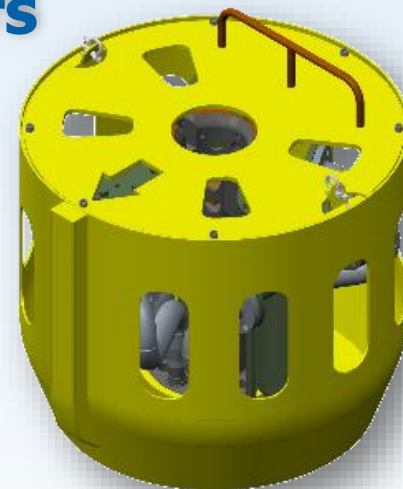
Subsea Filter Systems

- Suction Inlet Filter System Protects Pumps and CIMV's and Instruments from Contamination
- Modular in Design, ROV Torque Tool Latch, Easily Retrievable
- Three Filters per Module Assembly, Fill in Series
- Delta Pressure Sensors Indicate filter state
- A & B Pod, Removal of one will not Interrupt Operations
- May Include Discharge Filters based on Customer Preference
- Filtration to ISO 17 / 15 / 12 or SAE 7A / 7B / 7C

ISO 4406 Cleanliness Codes

Range Code	Particles per milliliter	
	More than	Up to / Including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Modular Filter Assy.



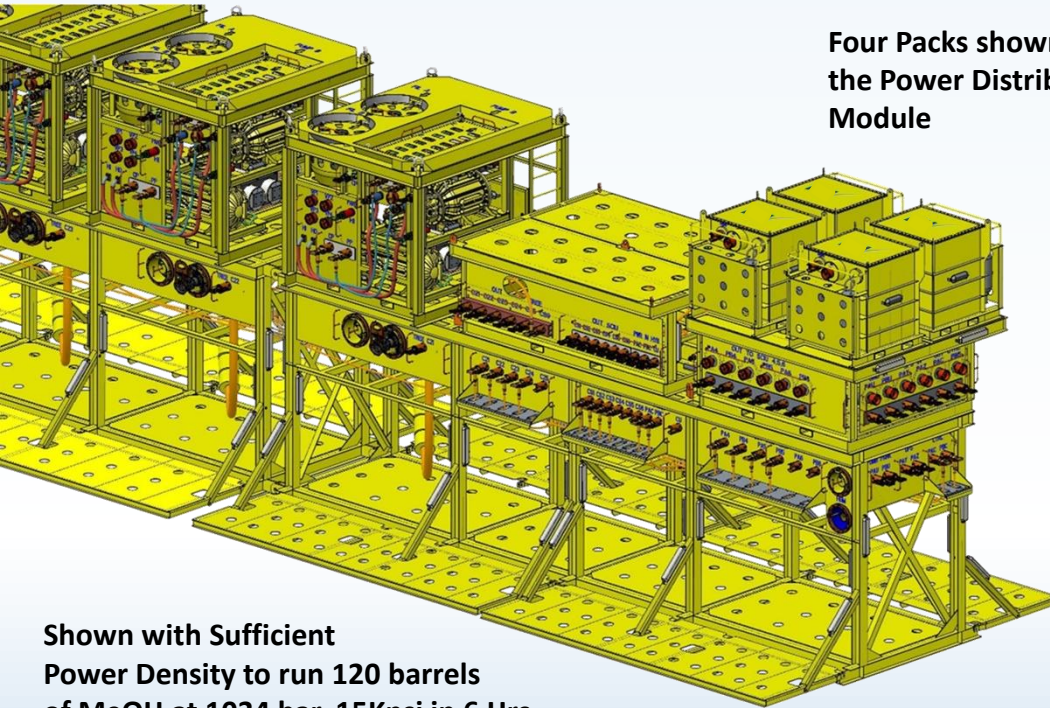
"A" Filter Mod

"B" Filter Mod

Subsea Chemical Injection Unit – Battery Supply

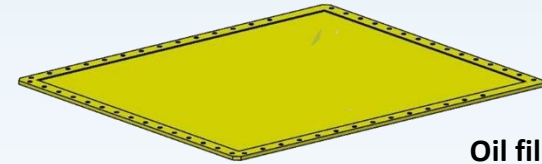
Battery for Intermittent Duty and Backup

- High Power Density Lithium Battery Packs
- Single Pack has 188kWh Power Capability
- Multiple Packs Can Be Used
- Power Inverter for conversion of DC to AC
- Dramatically Reduces Copper Wire Demand in Umbilical

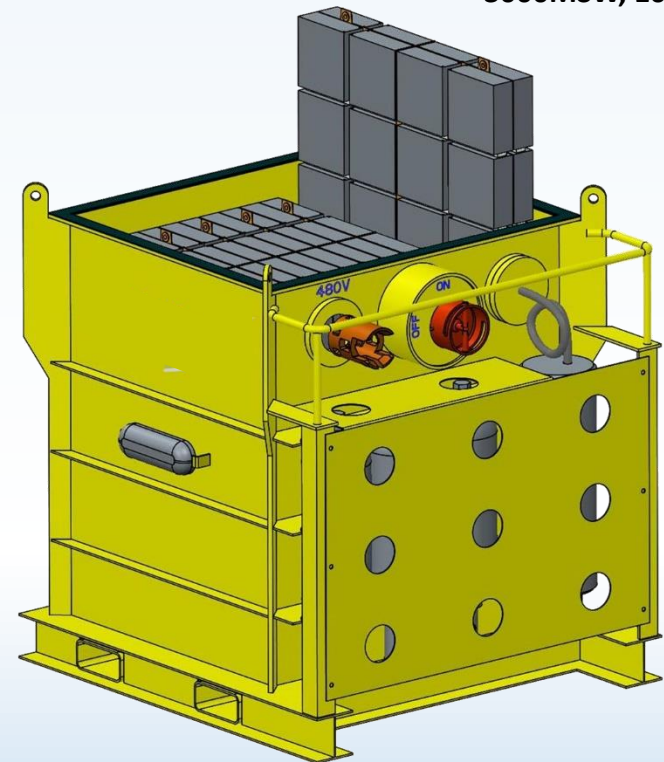


Four Packs shown on the Power Distribution Module

Shown with Sufficient Power Density to run 120 barrels of MeOH at 1034 bar, 15Kpsi in 6 Hrs.



Oil filled, 100% Compensated for 3000MSW, 10KFSW

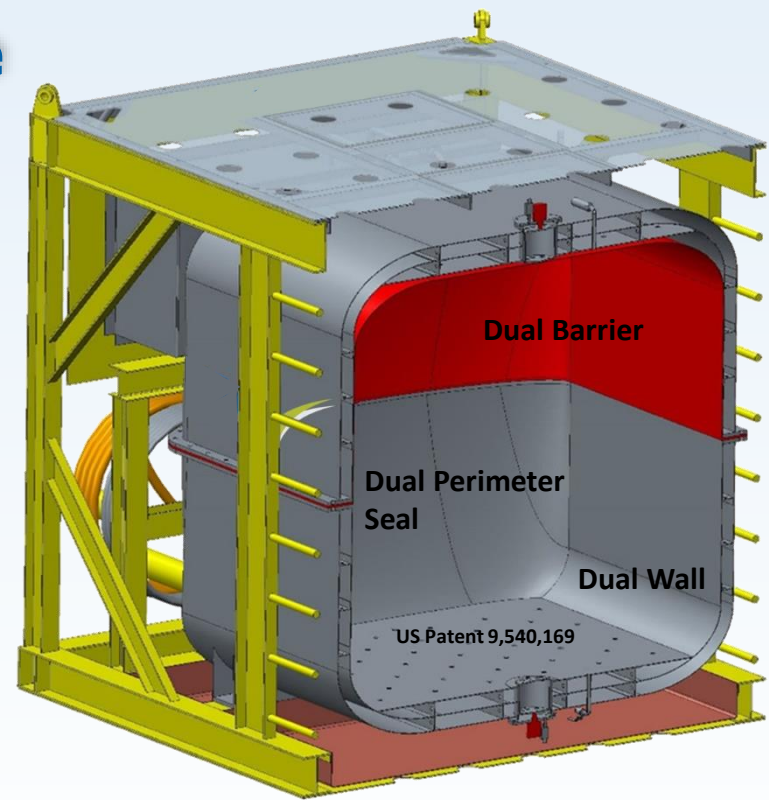


Lithium Battery Pack

Subsea Chemical Injection Storage

Subsea Chemical Storage – Sea-Tote

- Dual Tank Wall, Fluid Filled, Test Anytime
- Dual Liner, Oil Between Layers, Test Anytime
- Dual Perimeter Seal, Test Anytime
- Over-Fill, Over-Suction Hard Stop Limit Switch
- Relief System for Accidental Over-Fill
- Relief Bellow Tank Automatically Vents to Suction Inlet
- Flowmeter Measurements for Fluid-in, Fluid-out, Water-in, Water-Out
- ROV Free-Fly Connections

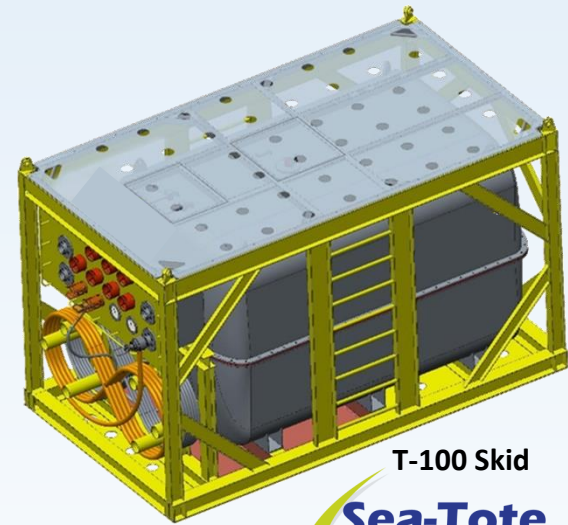
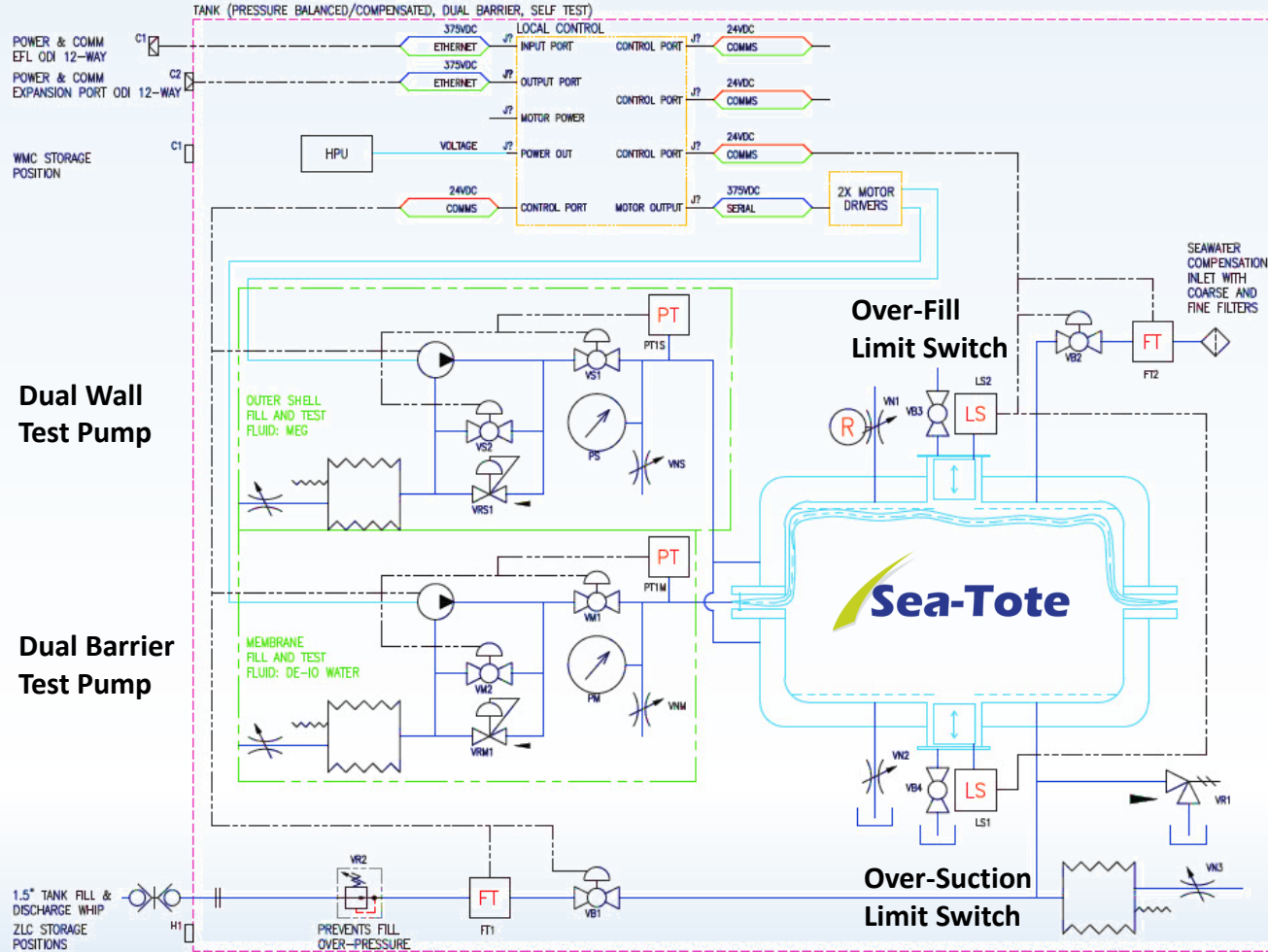


Tank Fluid Volume & Weight Analysis

Tank Calculator	Inside Width	Inside Height	Inside Length	Tank Volume			Volume's weight of		Comparison Fluid		SG Effect on Weight
	Ft (m)	Ft (m)	Ft(m)	ft3	gallons	barrels	m^3	water - lbs.	Density (SG)	Weight - lbs	Difference
Small	7.2 (2.2)	6.9 (2.1)	11.3 (3.44)	561	4,199	100.0	15.9	35,000	1.05	36,800	1,800
Medium	7.2 (2.2)	6.9 (2.1)	22.6 (6.9)	1,123	8,399	200.0	31.8	70,000	1.05	73,500	3,500
Medium2	8.2 (2.44)	7.9 (2.41)	17.5 (5.33)	1,134	8,480	201.9	32.1	70,700	0.79	55,900	-14,800
Large	8.2 (2.44)	7.9 (2.41)	26.7 (8.14)	1,730	12,938	308.1	49.0	107,900	0.79	85,200	-22,700
Shuttle	54 (16.5)	8 (2.44)	40 (12.2)	17,280	129,263	3077.7	489.3	1,078,100	0.79	851,700	-226,400

Subsea Chemical Injection Sea-Tote Safety

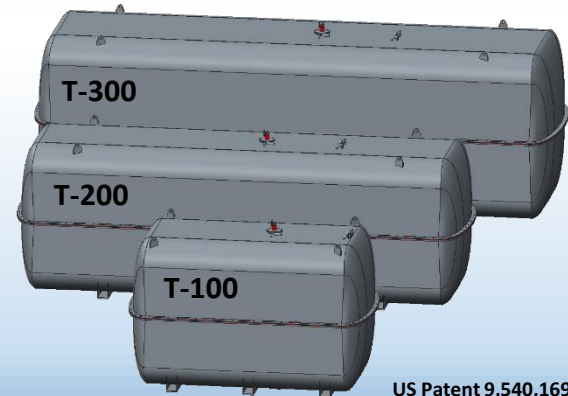
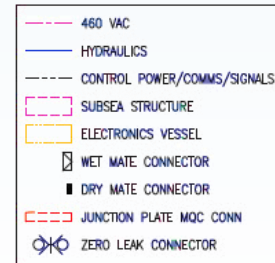
Subsea Tank Sea-Tote



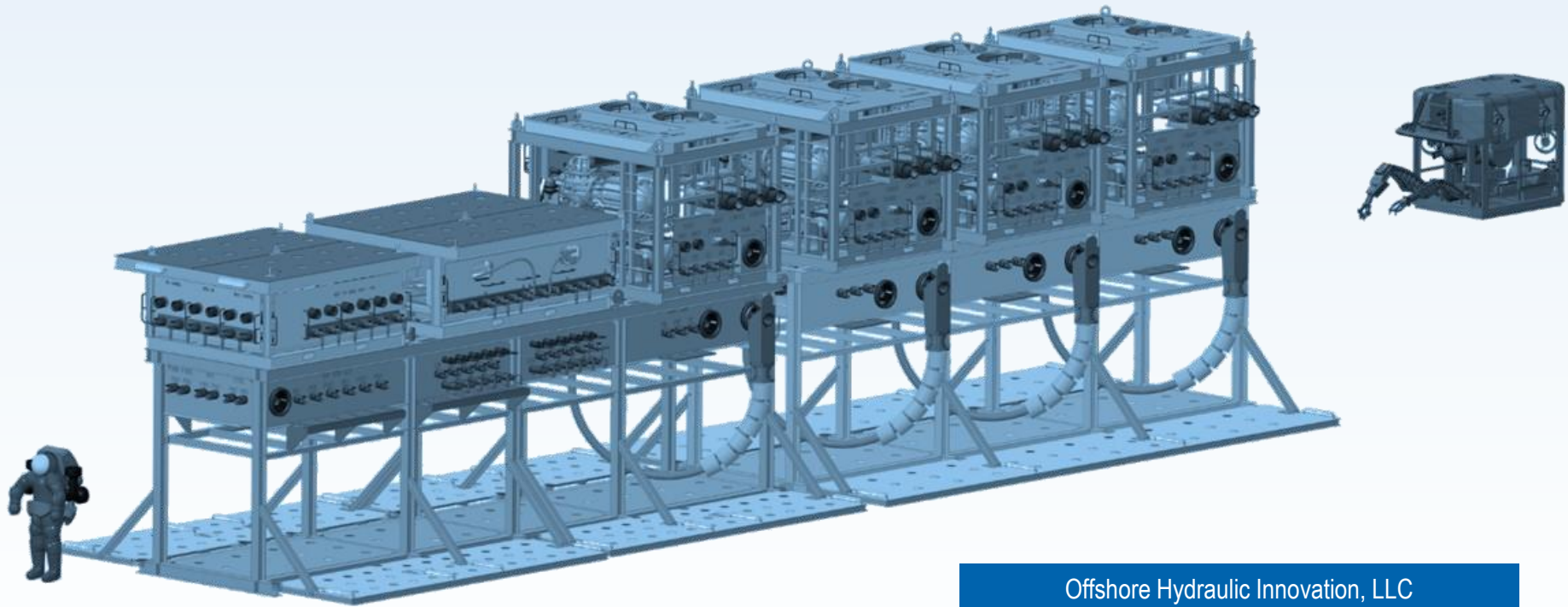
T-100 Skid



Water Compensation Inlet and Filter



US Patent 9,540,169



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