



WHITE PAPER

Sectioned Modular HPU

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W-Industries specializes in the custom design and fabrication of engineered packages for a broad range of applications in the energy industry.



HPU with Integrated HCU Design at W-Industries, Charles Rd.

Pioneering HPUs with Expansion Capabilities

A Hydraulic Power Unit is a self-contained system that provides clean and reliable hydraulic energy for consistent control and operations of a wide variety of equipment downstream, including subsea controls, topside actuated valves and IWOCs.

Typically, a HPU consists of a reservoir, pumps, motors, filters, accumulators, valves and instrumentations. In the late 1990s, W-Industries pioneered the ability to expand standard HPUs by adding external skids that could be tubed to the HPU enabling the ability to increase capacity. This design was further enhanced by reconfiguring the HPU enclosure itself to house the expansion modules, also known as Hydraulic Control Units (HCUs). An HCU houses the components from the regulator to the supply output.

With this design, the end user can commit to a set number of umbilicals and outputs at the time of commissioning, while also having the flexibility to add more umbilical outputs in the future.

All W-Industries hydraulic systems are custom-designed solutions made specific to each client's needs. Our small skid offerings fit in a 4' x 4' envelope, while our largest units grow to 30' x 20' in size.

Modern Solutions for Antiquated Problems

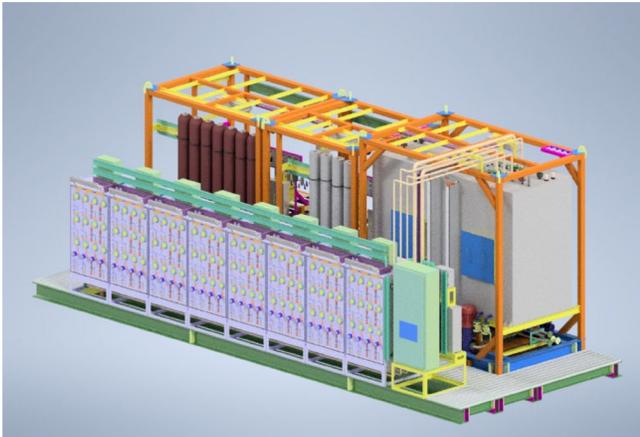


Sectioned HPU with HCU's Offshore

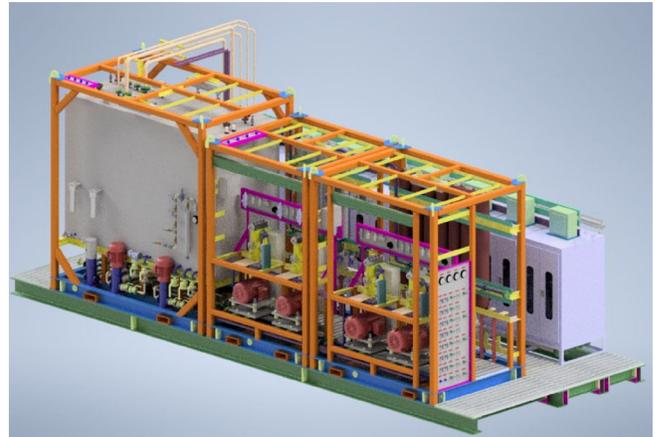
As industry evolves to address new challenges, antiquated assets must be modernized to meet new demands. Installing and setting up a new HPU when a platform is bare can be a challenge in and of itself, but replacing an existing HPU when the platform has been in operation for decades presents another trial of its own. Larger HPUs are often more difficult to navigate into place with other structures already erected, whether positioned with a crane or on skates.

Weight and size restrictions being a key factor in the offshore installation process, W-Industries' developed a solution to the problem by dividing the HPU itself into separate sections. Interconnecting tubing is used to connect the entire assembly together. These components are joined and tested at our facility prior to installation offshore.

The unregulated portion of the HPU is separated into smaller skids. Depending on the size and weight restraint, it could be split into a reservoir skid housing the reservoir and circulation piping and an accumulator and pump skid for the HP and LP circuits.



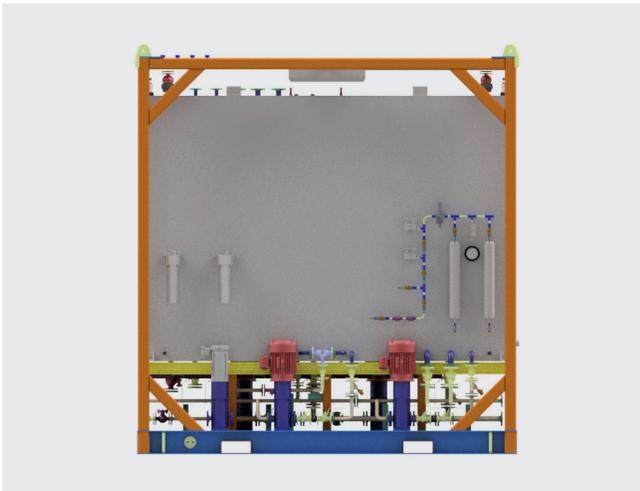
Assembled Sectioned Modular HPU - HCUs & PLC View



Assembled Sectioned Modular HPU - Reservoir & LP/HP Skid View

Reservoir Skid

A typical reservoir skid houses a split reservoir, with the circulation circuit tied directly on the skid. This circulation circuits have dual filters for maintenance and operation, selector valves for pulling and return to either the supply or return reservoirs. Spare and expansion ports can be designed into the reservoir for possible future expansions.



Typical Reservoir Skid

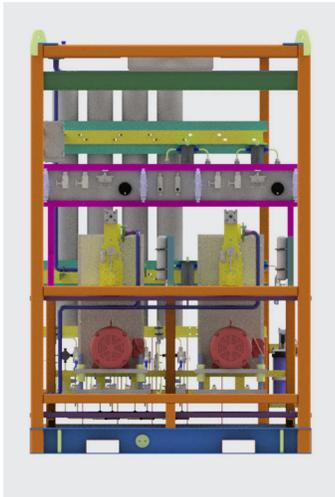
Available Features:

- Split Reservoirs w/ Supply & Return
- Redundant Circulation Pumps
- Redundant Circulation Filters
- Selector Valves w/ Position Indicators
- Expansion Flanges for Additional Reservoirs
- Overflow Protection & Breather
- Vacuum / Overpressure Protection
- Separate Hatches / Manways
- Level Gauges & Transmitters for Both Sections
- 316SS Piping for Circulation Line

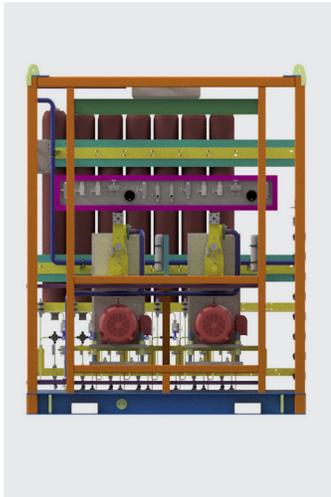
HP / LP Pump & Accumulator Skid

Each HP/LP Pump & Accumulator skid typically houses the unregulated circuit for the respective line. This includes the supply pump and motors, relief valves to protect the circuit from overpressure, a bank of accumulators with overprotection, pressure gauges and transmitters for easy reading and filtration before leaving the unregulated circuit.

Each accumulator bank includes relief valves to protect the hydraulic circuit and rupture discs to protect the nitrogen circuit. A panel is available for easy operation and pre-charging of the accumulators.



Typical HP Skid



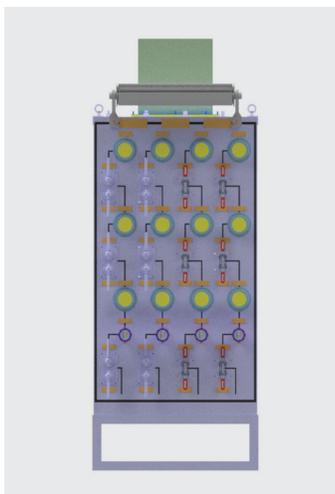
Typical LP Skid

Available Features:

- Stainless or Carbon Steel Structure with 4 Pad-eyes for Lift (DNV cert. available)
- Redundant Supply Pumps & Motors for Unregulated Pressures Up to 20,000 psi
- Overpressure Protection (PSVs)
- Pressure Gauges & Transmitters
- Accumulator Bank w/ Expansion Slots
- ASME Accumulators PSVs, RDs
- Double Block & Bleed Isolations
- Nitrogen Pre-Charge Lines for Accumulators
- Redundant Supply Filters for Maintenance
- Tubing Options: 316SS, 317SS, 2507

Hydraulic Control Units (HCUs)

The HCUs house the regulated circuit. The front side of the HCUs contain all panel mounted components, including valves for operations, pressure gauges, flowmeters and regulators. Internal to the HCU include the remaining instrumentation equipment such as ESD valves and relief valves. A junction box is mounted on top of each HCU for all communication and power connections.



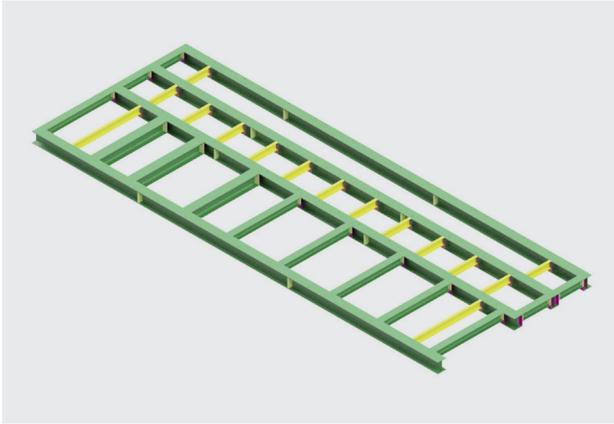
Typical HCU

Available Features:

- 316SS Enclosure with 2/4 Pad-eyes for Lift
- Panel Mounted Assembly for Ease of Controls
- Regulator Designed for Pressures Up to 15,000 psi with Optional Bypass
- 2 HP & 2 LP Supply Outputs
- Flowmeter with Optional Bypass Line
- Pressure Gauges and Transmitters for Feedback to PLC
- Air Actuated Emergency Shutdown (ESD) Valve Assemblies
- Crossover Lines for Maintenance
- Junction Box for Comms & Power to/from PLC & HMI
- Tubing Options: 316SS, 317SS, 2507

Spreader Beam

All of the modules are installed on top of a spreader beam assembly - distributing the weight across the existing platform beams. Both grating and drains can be incorporated as part of the spreader beam design. Once the entire skid is assembled, it becomes a fully functioning HPU with extensive expansion capabilities.



Available Features:

- Entire Assembly Made of Carbon Steel W-Flanges
- Spreader Beam Coated for Offshore Conditions
- Sermagard ASTM Bolts for Mounting Skids onto Spreader Beam
- Pre-Tapped Holes for Ease of Installation Offshore
- Primary Beams to Span Across Platform Beams and Welded
- Drainage and Grating Can Be Integrated

The entire assembly is fully assembled, along with piping, tubing and cabling at a W-Industries facility. The typical FAT consists of a hydrostatic test, flushing test, leak test and functional verification testing. Once testing is complete and all requirements fulfilled, the skid is disassembled, labeled and crated for reassembly offshore.

Future Expansion Capabilities

Both the HP and LP accumulator and pump skids can be designed with spare slots available to accommodate future accumulators. Tubing and valves can be ran to the spare slots, with plugs to block off use until the additional accumulation is necessary.

The reservoir skid can be designed to have expansion ports for a secondary reservoir. Additional HCU's can be supplied down the road, with each HCU providing two additional HP and LP regulated supply lines.

Modular & Sectioned Modular Design History

Below is a list of projects designed and commissioned by W-Industries.

Modular Design:

- Shell Llano HPU
- Shell West Boreas HPU
- Shell Appomatox HPU
- Shell Stones HPU
- Freeport McMoran Holstein Deep HPU
- Freeport McMoran Horn Mountain KOQV

Sectioned Modular Design:

- Shell BC-10 MLP HPU
- Shell Europa HPU
- BP Na Kika Life Extension HPU