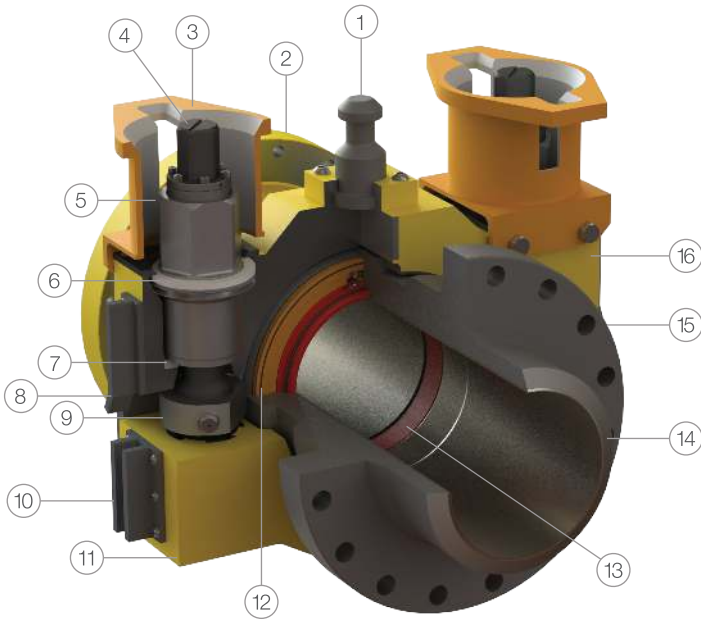


INTEGRATED SUBSEA PRODUCTION SYSTEMS

Delivering Cost-Effective Technologies and Efficient Project Execution

Virtus™ Connection Systems

The Retlock® connector and its sealing technology is the cornerstone of AFGlobal's *Virtus* connection systems. With a total of 1,750 connections worldwide and over 25 years proven field life, the *Retlock* connector is a robust twin-bolt system designed to provide optimum performance at water depths to 3,048m. By using a compact twin bolt design, makeup torque requirements are reduced, providing an efficient installation with low residual component stresses. The *Retlock* bolts are engaged with twin torque tools that are synchronously driven by the connector control system. The *Retlock* connector includes a retrievable metal-to-metal gasket. The broad gasket sealing face is large enough to prevent the joining of multiple sand gouges, which can form a leak path.



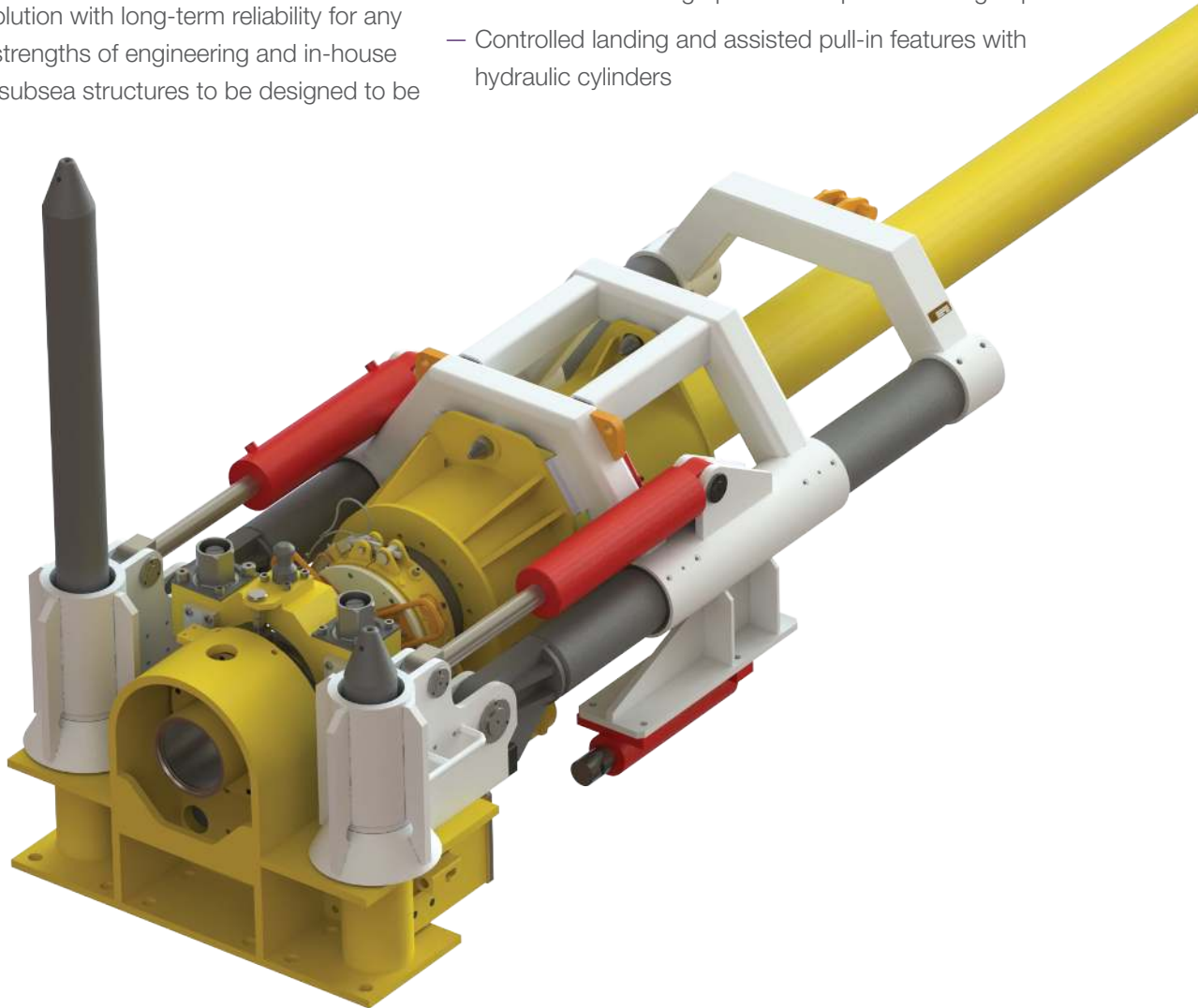
VIRTUS™ CONNECTION SYSTEMS		
ITEM	DESCRIPTION	QTY
1	Lifting Mandrel	1
2	Inboard Hub	1
3	Torque Bucket Receptacle	2
4	Retlock Shaft	2
5	Main Nut	2
6	Debris Seal	2
7	Spherical Seat	2
8	Upper Clamp Guide	2
9	Shear Screw Assembly	2
10	Lower Clamp Guide	2
11	Lower Clamp Half	2
12	Seal Plate	1
13	Metallic Gasket Seal	1
14	Hub Interface (Weld nib or flanged)	-
15	Outboard Hub	1
16	Upper Clamp Half	1

Connection System	DMAc	FTC	VTC	RTC	MPC
Orientation	Horizontal	Horizontal	Vertical	Oblique	Horizontal
Guidance System	<ul style="list-style-type: none"> Winch-in system 	<ul style="list-style-type: none"> Run-to-Place system 	<ul style="list-style-type: none"> Run-to-Place system 	<ul style="list-style-type: none"> Run-to-Place system or Winch-in Drag-to-Place system 	<ul style="list-style-type: none"> Fly-to-Place system
Attributes	<ul style="list-style-type: none"> Flexible jumper connection Suited to application in areas with harsh environmental conditions Ability to wet park jumpers for later installation Ability to connect/disconnect PLRs Facilitates subsea reconfiguration 	<ul style="list-style-type: none"> Versatile low cost system for connection of: <ul style="list-style-type: none"> Rigid and flexible pipelines Rigid and flexible jumpers Umbilicals PLRs Stab and Hinge over and lay away Guidelines or Guidelineless 	<ul style="list-style-type: none"> Rigid/flexible jumper connection Allows wet parking of rigid jumper without final connection Guidelineless Small footprint Saves costs as crane vessel is not required for full installation Controlled landing 	<ul style="list-style-type: none"> Orientation flexibility Potential synergy between Riser Tower and Riser Base connections Subsea winching or direct pull-in of Riser Guidelines or Guidelineless 	<ul style="list-style-type: none"> Low cost Fully adaptable to different vendors couplers Umbilical snag protection Can be configured for chemical injection, instrumentation, flow meters, DP cells.
Applications	<ul style="list-style-type: none"> Manifold—XT Manifold—FLET Flexible Riser—FLET PLR - Manifold or PLET 	<ul style="list-style-type: none"> Manifold—XT Manifold—Pipeline Manifold—PLR XT—Pipeline Riser Base - Pipeline 	<ul style="list-style-type: none"> Manifold—XT Manifold—Pipeline XT—Pipeline Riser Base - Pipeline 	<ul style="list-style-type: none"> FPSO flexible Riser—Riser Tower (URA) Riser Tower Base (LRA)—FLET (pipeline) Flexible Riser—FPSO—Offshore loading vessel 	<ul style="list-style-type: none"> Flying leads instruments ROV replaceable instrumentation
NPS	2-12 inch		2-24 inch		-

Subsea production and processing systems are only as reliable as the connections that link the equipment together. AFGlobal's *Virtus*™ diverless connection systems are engineered, built, and delivered with a focus on reducing the risks associated with subsea connections. Each connection needs to be safe and reliable to avoid operating problems that can hinder or completely halt production. Connection failures anywhere along the pathway from the wellhead to the platform may leak oil or gas into the ocean, creating costly and potentially catastrophic damage to the marine ecosystem. Adding to these risks is the reality that subsea production infrastructure has to transport harsher, higher-temperature and higher-pressure production fluids from deeper waters—making the long-term reliability and safety of the connection systems a top priority. Whatever your subsea connection challenge, AFGlobal has a solution. The versatility and completeness of the *Virtus* series of diverless connection systems means that we can provide a cost-effective connection solution with long-term reliability for any scenario. The shared strengths of engineering and in-house manufacturing enable subsea structures to be designed to be

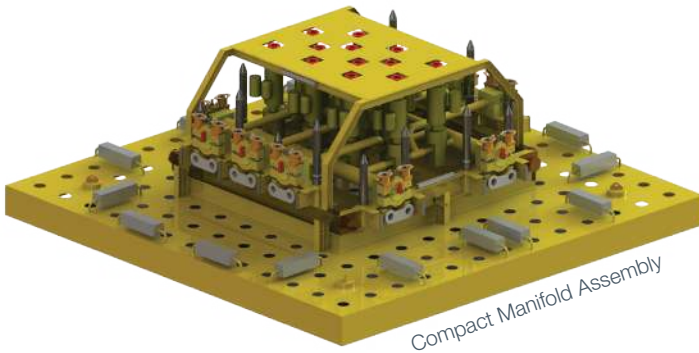
the most lightweight and compact arrangement possible. Our connection systems are engineered to deliver technical advantages that include:

- Contingencies, including secondary clamp release
- Risk mitigation features, including a recessed inboard hub protected by the subsea structure, which lowers the risk of damage from dropped objects
- High mechanical load capacity
- Ease of installation and wet parking features, which reduce the install costs associated with an installation vessel
- An optimized size and weight, which helps minimize the size of the host structure and helps eliminate the need for heavy running tools
- Efficient installation with technologies designed around minimizing installation vessel times
- ROV recoverable high pressure caps or flooding caps
- Controlled landing and assisted pull-in features with hydraulic cylinders



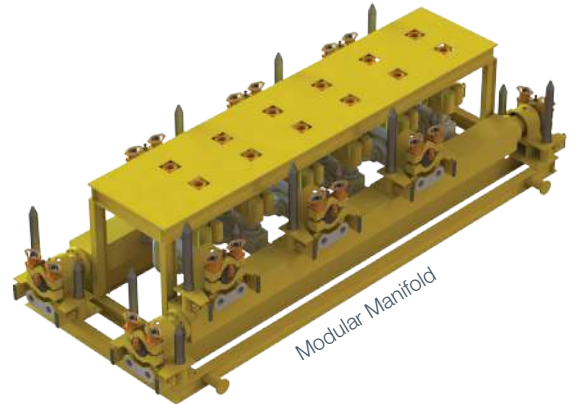
Integrated Systems

The design and engineering of subsea manifolds by AFGlobal goes back two decades. AFGlobal's compact manifolds are cost effective gathering solutions for a multitude of installations. The AFGlobal compact manifold uses the *Virtus* flowline type connector (FTC), a horizontal connection system designed for use with rigid or flexible pipelines/flowlines. The compact manifold does not sacrifice performance or functionality versus the project requirements of standard vertical manifold solutions.

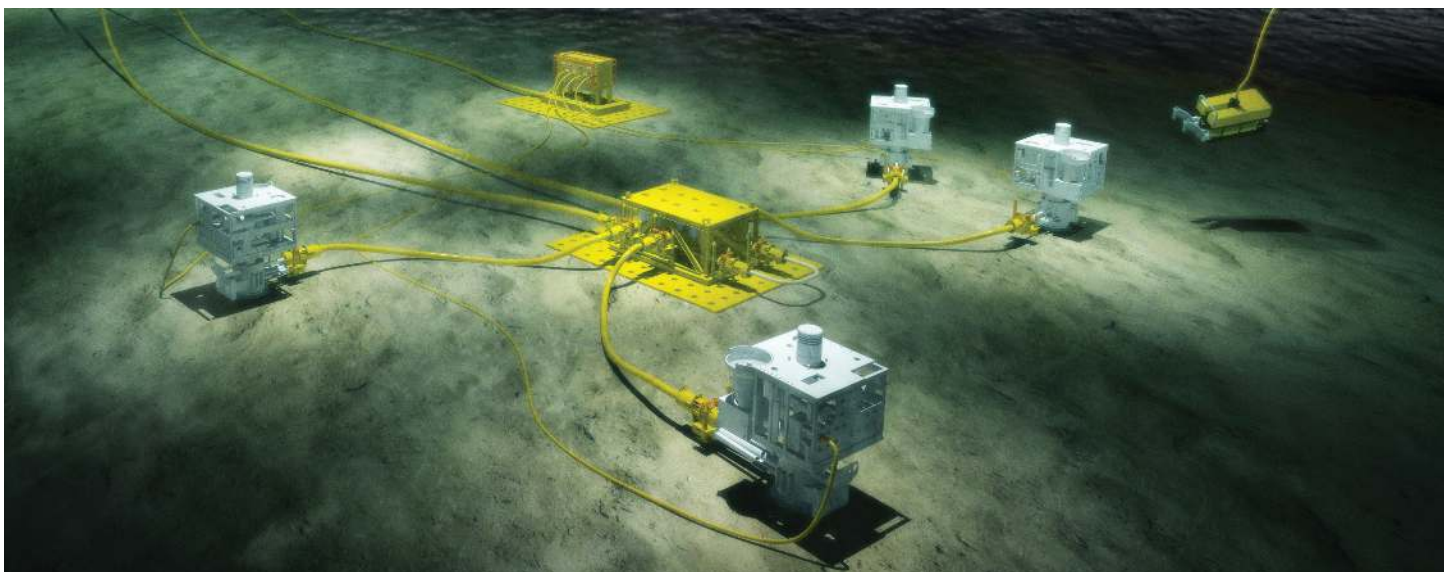


The AFGlobal compact manifold offers a direct weight savings of 25-40 percent with an equally discounted footprint. The piping kit of the compact manifold eliminates all 5D bends in the manifold structure (5D bends do not allow for a reduced structure height). This kit can reduce the piping weld count by 50 percent or more. This significant reduction in piping welds translates to a lower cost, shorter schedule, and reduced risk associated with subsea manifold fabrication.

AFGlobal's modular manifold features one of the most compact designs on the market today. It helps eliminate fabrication risks and enables efficient assembly and test in remote locations to help satisfy local content requirements. This bolt-together piping kit minimizes both the number of pressure containing welds and pressure containing flanged connections. The flange connection technology of the modular manifold is AFGlobal's proprietary and extensively field-proven Taper-Lok® engineered sealing

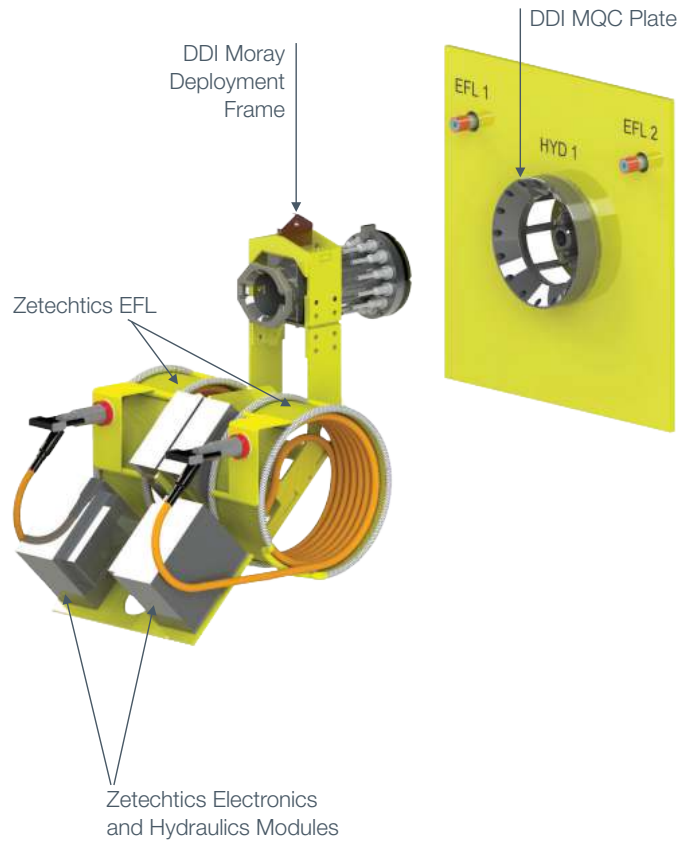


technology. The *Taper-Lok* technology provides for compact, light-weight flange connections with extremely high temperature, internal pressure, and external pressure capabilities that far outperforms even the most challenging ultra-deepwater HPHT design requirements. The flange connection technology uses a self-energizing seal that also provides unrivaled misalignment capabilities. The *Taper-Lok* technology complements the compact modular manifold's efficient design. As an alternate, the client's flange connection of choice can be used.



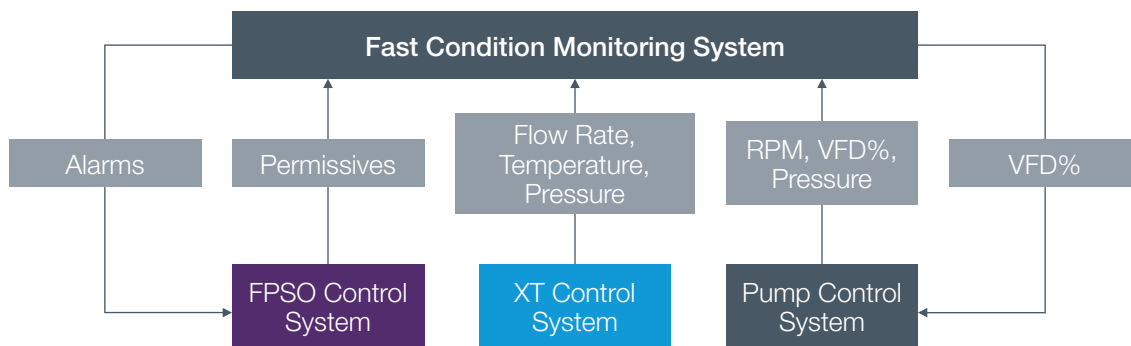
Universal Subsea Control Systems

The patent-pending *Virtus* Universal Subsea Control system (USC) is depth rated to 4,000 meters and is installable on virtually any subsea hardware package. The system is ROV installable and retrievable using industry standard tooling and couplers. It is constructed from field-proven modular components from Deep Down, Inc. and Zetechtics that are designed to be low cost, with short lead times—and designed to last for decades. The user configurable Jupiter 2 software enables efficient topsides control and eliminates data bottlenecks found in traditional subsea SCMs by using standard Internet of Things (IoT) architectures.



The integration of independently supplied OEM systems for tree production and pump control is necessary to avoid frequent manual adjustments, enable real-time optimization of field production—and to minimize the risk of catastrophic pump damage due to changing flow conditions upstream and downstream of the pump module. This can be accomplished by implementing a fast condition monitoring system.

This system can be integrated into all other OEM systems to collect data and output a focused set of instructions intended to minimize the human interaction needed to make real-time adjustments to the subsea pumping system. As an added benefit, the fast condition monitoring system could easily log and correlate all production system process information into one consolidated format.



Complementary Technologies



Insulation and Buoyancy

AFGlobal is one of the largest manufacturers of subsea buoyancy and insulation products in the world. The broad variety of materials and manufacturing methods developed over the years helps ensure the best selection of products and materials in the market. The foundation of AFGlobal's buoyancy portfolio stems from the acquisition of two industry pioneers—Flotation Technologies and Cuming Corporation. These well-established brands feature deep experience in designing and delivering deepwater deployment solutions and form the basis of today's Flotec™ series of buoyancy and insulation technologies.



Deep Down, Inc.

The strategic alliance between AFGlobal and Deep Down delivers fully synchronized and integrated subsea production solutions. AFGlobal and Deep Down together provide cost-effective technologies, highly experienced engineers and service professionals—and project management excellence for all of your integrated project needs.



Zetechtics

The strategic alliance between AFGlobal and Zetechtics brings together decades of experience in subsea hardware and software for seamless functionality offshore. Zetechtics has been manufacturing the Jupiter subsea control system since 1998 and have supplied hundreds of solutions into the offshore oil industry. While the primary market for Jupiter systems is deepwater control, the core of Jupiter functionality is the surface software running on a conventional Windows PC. This software can be applied to provide powerful control of surface systems in a cost effective solution to large scale process control challenges.



Pacson

AFGlobal valves are offered to market through a vertically integrated alliance with industry experts, Pacson Valves. The extensive experience and well-proven technologies of Pacson Valves provide the necessary foundation to continue development for increasingly demanding design criteria. As a bespoke valve manufacturer, Pacson Valves has been at the forefront of valve design, manufacture and qualification for over 25 years.



Engineering

AFGlobal's engineering capabilities include engineering and design of equipment and software systems from initial conceptual research and development through detailed engineering analysis, design, manufacturing, testing, certification, installation and support.

Global Locations



Western Hemisphere

Houston, TX
Avon, MA
Detroit, MI
New Iberia, LA
Woodville, TX
Calgary, Canada
Macaé, Brazil

Eastern Hemisphere

Dubai, UAE
Shunde, China
U.K.
Indonesia
Malaysia
Papua New Guinea
Singapore

Aftermarket Services

AFGlobal offers a full suite of aftermarket services to manage everything from mobilization to decommissioning. Our highly qualified offshore engineers are also competent to perform interface engineering through the writing of installation procedures and supervise offshore execution. From conception, our teams provide comprehensive engineering for every segment of production providing a customer-specific approach to application and risk management. Our ongoing support includes the technical capacity to develop subsea equipment that adapts to changing field architecture, while minimizing disruptions from localized decommissioning during product repairs, interventions, or replacements.



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