

Denizen™ Subsea Systems

Minimize crew and vessel requirements for maximum economic impact

Baker Hughes, Process & Pipeline Services (PPS) offers a comprehensive alternative to the large equipment spreads that are typically required for deep water pre-commissioning.

Optimize your project budget with our patented Denizen™ Subsea System, while minimizing weather-related delays, reducing the project carbon footprint and enhancing personnel safety.

Meet the fleet

The technologies employed on the subsea systems are mature, reliable and complemented by an experienced team of technicians and engineers who see each project through, from concept to execution. From flooding to hydrotesting and subsequent dewatering, the Denizen Subsea Systems have you covered.

Features and benefits

- Minimize crew and vessel size requirements
- Reduce weather-related downtime
- Perform pipeline flooding and hydrotesting on multiple pipelines simultaneously
- Pig speeds are not restricted by high-pressure losses from downline friction
- Subsea datalogger runtime up to 30 days

Flooding module



Hydrotesting module



Combined Flooding/Hydrotesting module (CTS)



Coiled tubing downline system



Denizen™ flooding module



When a new subsea pipeline is installed, it typically contains air at atmospheric pressure (1 barA / 14.5 psiA). The first deepwater pre-commissioning operation is to fill it with sea water to allow for a hydrotest to be performed. To ensure the pipeline is filled, a single pig is typically used, which will act as a cleaning and gauging pig.

The Denizen™ flooding module connects to the subsea pig launcher and, using the ambient hydrostatic head pressure, will launch the cleaning and gauging pig through the pipeline. This is the “Free-Flooding” phase.

During flooding, the water is drawn through 50 micron filters and is dosed with chemical(s) to the required dosage rate. Flowrate is controlled using the onboard flow control device.

Free-Flooding will continue until the pipeline pressure reaches equilibrium with the subsea ambient hydrostatic head pressure – this is approximately 95-99% of the pipeline volume. The final 1-5% is completed using the onboard pigging pump, which is powered by the hydraulics of a work-class ROV.



During flooding operations, critical information is recorded on the subsea dataloggers, including:

- Water-flow rate
- Chemical ppm
- Water volume
- Chemical volume
- Differential pressure across filters
- Injection pressure

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Denizen™ hydrotesting module



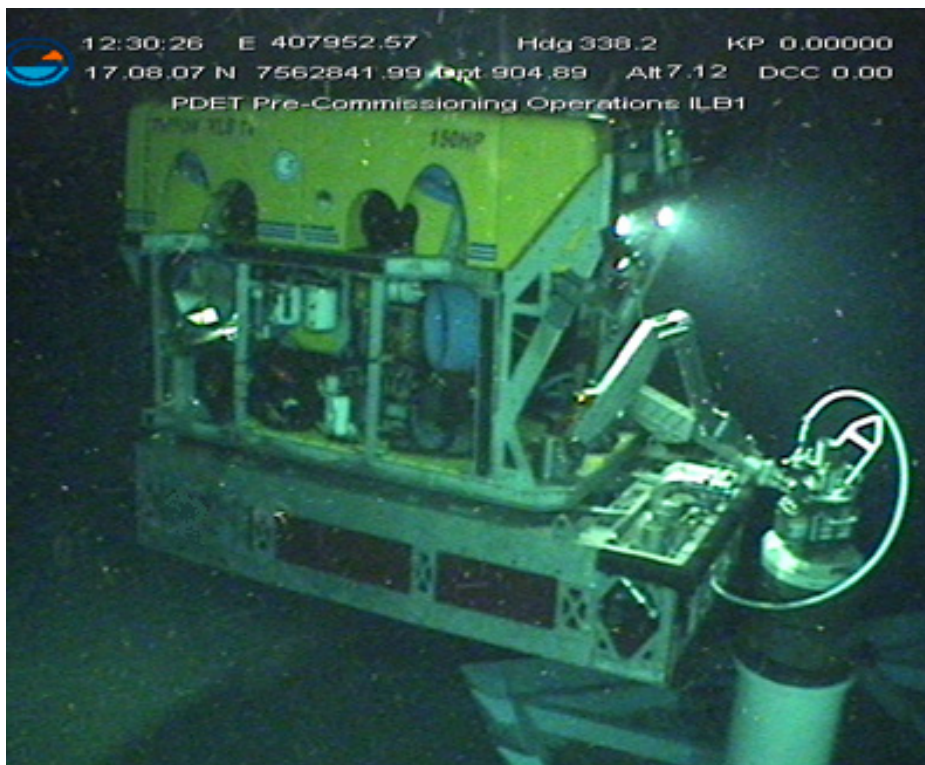
After the pipeline is filled with chemically treated and filtered water, the system is ready to be hydrotested. With Denizen, the water to fill the pipeline has been drawn from the subsea location, therefore minimal thermal stabilization time is required. This can represent a significant schedule reduction compared with water pumped in from a warmer surface location.

The Denizen subsea test manifold (STM) is deployed and landed next to the Denizen™ hydrotesting module. With the hydrotesting module connected to the STM, the STM connects to the pipeline injection tie-in point via their respective hotstabs. ROV will re-arrange the hydrotesting module and STM valves and begin pressurization. The Hydrotest Module can be configured with both high and low flow pumps, capable of pressures up to 1,380 bar (20,000 psi), again the pumps are powered by the ROV hydraulics. The test manifold of the STM can be adapted to allow testing of more than one subsea system at a time.

Pressurization commences at a rate no greater than 1 bar/min (14.5 psi/min), with intermediate hold periods. Injection water is treated with the project chemical(s) and, once at the nominated test pressure, the hydrotesting module and STM are locked in. Pressure and temperature are monitored for the duration of the test.

Upon completion of a successful test, the system being tested is depressurized through the hydrotesting module/STM in a controlled manner using a flow control device.

The system is configurable to allow for acoustic or optical data modems to transmit the hydrotest data from the subsea test locations. Additionally, removable data loggers can be utilized to recover test data without recovering the Denizen system.



During hydrotesting operations, critical information can be recorded, including:

- Water-flow rate
- Chemical ppm
- Water volume
- Chemical volume
- Ambient temperature
- Pipeline pressure

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Denizen™ combined flooding and hydrotesting system

Both the flooding and hydrotesting module can be deployed as one multi-functional unit. For certain subsea pipeline systems, this can yield a significant reduction in overall vessel time. The deeper the water, the more time-consuming crane and ROV deployment operations can be. With this in mind, the Denizen system is designed to

be flexible and efficient, therefore minimizing the number of deployments required on a project. Furthermore, the ability to combine the flooding and hydrotest modules also reduces vessel deck space requirements and equipment mobilization costs.



Denizen™ coiled tubing downline system (CTS)

Traditionally, deepwater vessel-based pre-commissioning spreads have been connected to a subsea pipeline via a rubber hose or small-bore (<2") coiled tubing string. This temporary connection acts as a conduit for the pre-commissioning fluids / gases and is known as a "downline".

The downside of the rubber hose downline is the time and labor-intensive deployment and recovery procedure. Further, the multiple hose joins in the downline create a challenge in mitigating the leak paths. With small bore coiled tubing systems, the pressure losses in deepwater either limit the pigging parameters or required a large and powerful pumping spread to overcome the losses.

The Baker Hughes, Process & Pipeline Services Denizen coiled tubing downline system (CTS) was designed to overcome the shortfalls of the traditional downline methods.

Our CTS is capable of operating in water depths up to 3,000 m (9,842 ft) and designed for large diameter coiled tubing strings of 2.88" or 3.5".

DNV-certified to allow offshore lifting, the Baker Hughes CTS is road transportable in two loads, and the flexible frame allows use on a wide variety of vessels, either through a moonpool or over the side.

Some of the benefits of using our CTS include:

- Large downline diameter allows high flow rates at low pressure drops.
- One continuous coil section from vessel to seabed minimizes leak paths.
- Self-supporting coil string allows for fast deployment and recovery with minimal personnel
- PPS experience in all deepwater arenas around the world
- The deployment skid and over boarding structure are specifically designed for vessel and pipeline pre-commissioning applications
- The module can be used to flood and hydrotest from the surface to the deepwater pipeline, delivering the required fluids and compressed gases required during pre-commissioning
- Coil tubing is collapse resistant at deepwater hydrostatic pressure, allowing pipelines to be fully depressurized.
- A flexible hose bundle connection from the end of the coil string to the pipeline is provided. This allows for quick connection to the pipeline by ROV. Swivels, buoyancy and emergency breakaway functionality is also included.
- DNV-certified lifting frames



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