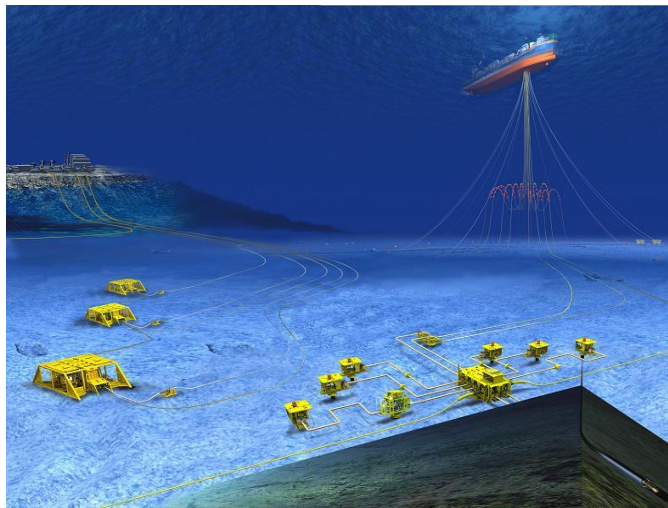




Subsea structures are the key building blocks for subsea infrastructure, connecting wells to flowlines and onwards to receiving onshore/offshore facilities. These structures must support and protect critical piping, equipment, subsea control and communication hardware for the life of the field, whilst providing easy diver/ROV access for critical intervention tasks all within an installable package. Reliable performance of these assets is critical to the success of a development, requiring great care and attention to detail.



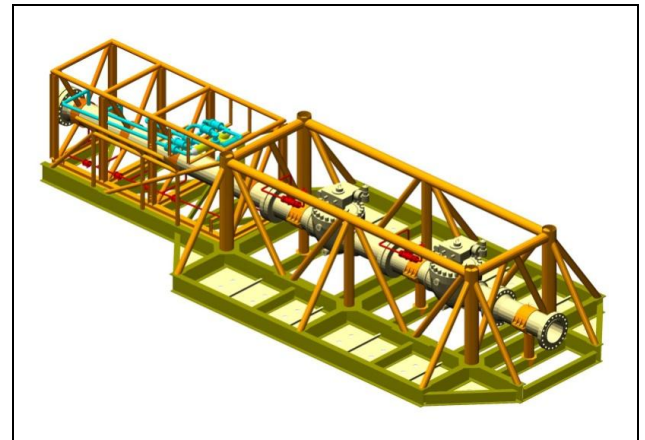
Bombora-ESP offers a comprehensive range of services for the design of subsea structures. Our considerable knowledge, experience and expertise in this field enable us to:

- layout and size subsea structures/manifolds to assist operators developing key architecture and installation strategies / methodologies, adding definition to project schedules and CAPEX estimates;
- develop optimal solutions within vessel operability limitations, foundation limitations, fabrication facility limitations, etc;
- validate solutions proposed by prospective vendors; and
- work closely with client, installation contractor and fabricator throughout the project to ensure suitability of final design and an optimised schedule.

Subsea/Pipeline System Structures

Bombora-ESP's engineers have experience in the design of subsea structures in deep and shallow water, including the following:

- Cluster manifolds.
- Pipeline End Terminations (PLETS) and Flowline End Terminations (FLETS).
- Pipeline End Manifolds (PLEMs).
- Riser bases.
- Subsea Isolation Valves (SSIVs) and valve stations.
- Wyes.
- Protection structures (CDUs, UTAs, tie-ins).
- Satellite structures for stand-alone wells.
- Subsea pig launchers and receivers in temporary, fixed or subsea re-installable configurations.
- Subsea heat exchangers.
- Controls distribution structures.



Related Structures

In addition, our skills/experience allow us to design:

- Pipeline/ cable crossing supports.
- Adjustable Pipeline Supports (APS).
- Subsea clamps.
- Buckle initiators.
- Control Distribution Units (CDUs).
- Umbilical Termination Units (UTAs).

Foundation Types

Our engineers have a wide range of experience in the design of piled, gravity based mudmats (skirted and unskirted) or suction pile foundations, with support from specialist geotechnical consultancies.

Design Considerations

Analysis requirements may include loadout, transportation, marine lifting and in-place analysis including hydrodynamic and earthquake loading. External loads from dropped object impacts, snagging and pipeline tie-ins can be addressed. Piping assemblies adjoining spools and foundations can be included in the global structural analysis to capture critical interaction effects.

In addition the following may also be considered:

- Diver/diverless installations and tie-ins.
- Diver/diverless intervention (valve operation, equipment installation / retrieval).
- Piping coatings and insulation.
- Cathodic protection.
- Design of piping clamps and guides.
- Materials selection.
- Development of procurement specifications.
- Development of fabrication specifications.

Installation Assistance

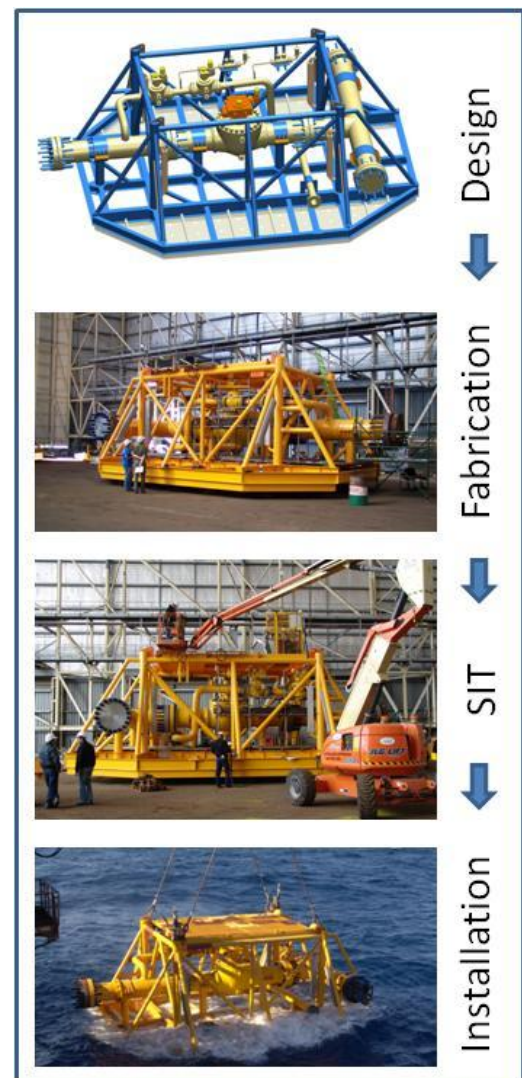
Bombora-ESP supports its clients by offering the following services to supplement our subsea structure design capabilities:

- Loadout and transportation analysis.
- Offshore lift analysis.
- Installation aids and rigging.
- Subsea templates.
- Equipment transport skids.
- Seafastings and tie-downs.
- Offshore container and basket design, fabrication and testing.
- Vessel deck extensions and platforms.
- Chutes/ diverters/ bollards/ bases/ sheave points.
- LARS frames (A-frames).

Phase of influence

Bombora-ESP's expertise can be employed throughout the various project realisation phases, including:

- Design (pre tender, detailed design and 3rd party review)
- Offshore geotechnical survey scope development, offshore support and results interpretation.
- Fabrication and SIT supervision
- Installation supervision



Please contact us to discuss your needs and requirements in more detail.