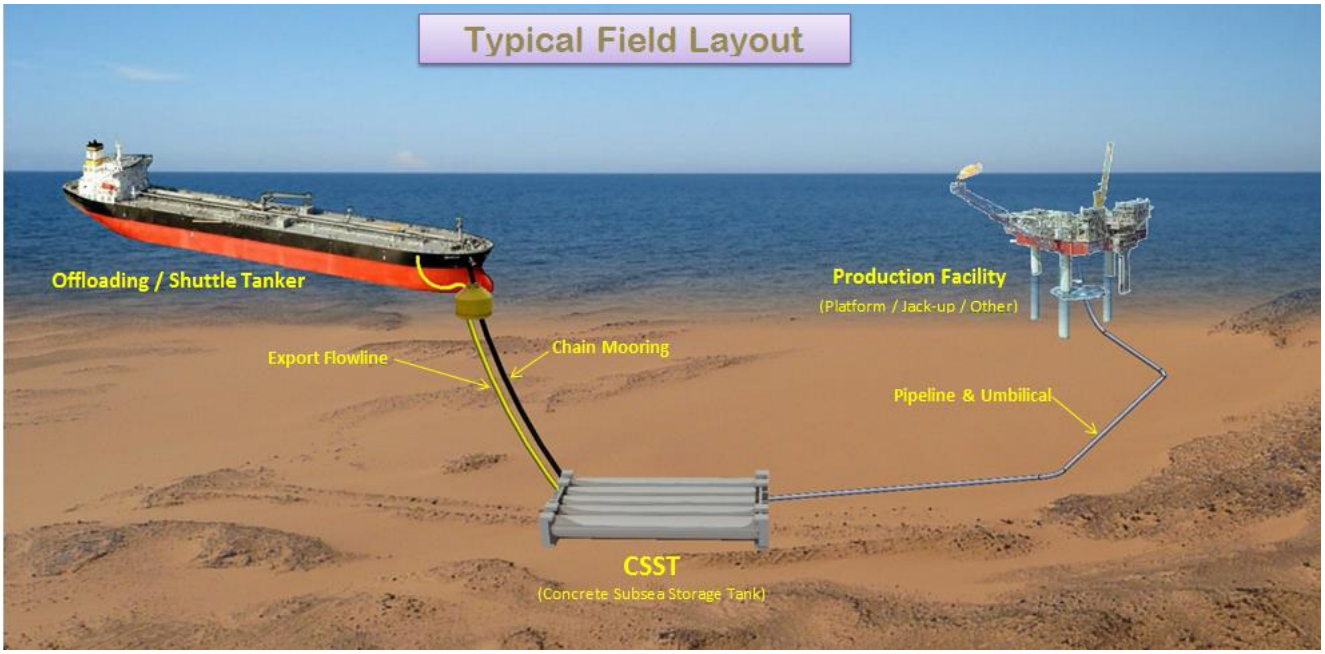
CONCRETE SUBSEA STORAGE TANK (CSST)

TENSA has developed a low cost oil storage system – **CSST** - that may be ideal for your oil storage needs. Sub-sea concrete oil storage is nothing new - it's been around for 50 years. What is new is the ability to install and readily relocate your storage unit to alternate field locations at minimal cost, the ability to moor your offtake tanker to the storage tank and the incorporation of a membrane to separate the oil and ballast water. All of the above are achieved by using very simple and easy to build tubular shapes.

The conceptual sketch below shows how the **CSST** would be integrated in a typical field lay-out. It can be readily configured to work with most field layout scenarios.



The **CSST** is designed for oil export to Shuttle Tankers. The **CSST** has a built-in tanker mooring system to accommodate the tanker during its offtake. Dependent on the actual field configuration and weather conditions, the tanker should ideally be Dynamically Positioned to allow unassisted mooring and to allow the tank to be located closer to the production facility. However this is not necessarily essential.

KEY FEATURES

- **No Cyclone Evacuation**
  The **CSST** remains safely on the bottom during cyclones. It can even remain operational during cyclones thereby minimising production downtime. The **CSST** is designed for the 100 year cyclonic storm, even in water depths as shallow as 20m. Compared to an FSO this can give an increase of up to 10 days of production each year in cyclonic locations.

- **Self-Installable**
  The **CSST** has been specifically designed for low cost installation. Ths tank will float, has multiple isolated buoyancy chambers and is towable with normal vessels. For shallow water installation **CSST** only requires the tow tugs needed for getting it to site. For water depths over 50m an extra dumb barge is required. The **CSST** does not require any expensive pre-laid moorings, nor does it require any seabed preparation - only a relatively level seabed. No rock ballast is required after installation.

- **Re-Locatable**
  The CSST is easily relocatable to an alternate site using tugs. Recovery from the bottom is via a vessel mounted de-ballasting spread that uses air to replace the seawater and refloat the unit. No heavy lift equipment is required.

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- **Low-CAPEX**
  The **CSST** can be offered on lease basis with no upfront CAPEX. In terms of Operations & Maintenance costs, only an annual ROV survey is recommended.

- **Membrane Separation**
  Produced crude and seawater are kept separated by an internal synthetic membrane. Seawater ballast is supplied and returned via a separate line from the production facility, ensuring that ballast water is clean before being discharged.

- **Designed for easy construction**
  By using tubular sections, the CSST can be built using conventional precast post-tensioned construction methods used for the construction of bridges and elevated freeways. The unit can be launched from a slipway or quickly assembled in a dock using precast elements.

DESIGN FLEXIBILITY

The **CSST** has been designed to afford operators maximum flexibility in order to best match their specific needs. The flexibilities catered for include:

- **Heating and/or Insulation**: Heating and/or insulation can be added for those crudes that require it. Flow Assurance studies will determine the extent of heating and/or insulation required for the complete **CSST** system, i.e. for: the riser/s and flow-lines to/from **CSST**; the crude storage tanks themselves and for any ancillary equipment added to **CSST**.

- **Dropped Object / Anchor Drag protection**: Pre-stressed concrete provides inherent resistance to dropped objects, however extra protection can easily be added if deemed necessary. By adopting conventional “Exclusion Zone” criteria, added protection can be kept to a minimum.

- **Foundations & Scour Protection**: **CSST** is suitable for almost all seabed types. **CSST** has been designed so that it is simply supported on its ends. All it requires is a relatively level seabed – no seabed preparation is required. In the unlikely event that scour protection is required, pre-installed roll out scour mats can be readily included.

- **Expandable Capacity**: **CSST’s** 2000,000 bbl. capacity can be readily expanded by adding additional units in parallel or in a daisy chain. Furthermore, a sub-sea tank farm can be created by the “daisy-chaining” of multiple **CSST** units. This feature caters for both the separate storage of different crude types from the same field/operator and keeping crudes from multiple field operators separate. Smaller versions of the CSST can be provided by using less tanks.

CSST

(Concrete Sub-Sea Storage Tank)

SPECIFICATION

Dimensions: Length = 100m; Width = 45m; Height = 12.5m
Capacity: 200,000 barrels
Depth Limit: 150m (500ft.)
Weight: approx. 35,000MT
Materials:
Storage Tanks: Pre-Stressed Concrete
Frame Structure: Concrete and/or Steel.
Internal Tank Membranes: Synthetic
Incoming Crude Pipeline: Either steel+flexible or all flexible/hose.
Offloading Export Line to Tanker: Flexible Hose
Tanker Mooring**:** Chain or synthetic

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