

LT 0000 MARK 00000

Principal Models of REFA T L C Cages					
Model	Principal Net-bag		Rearing Volume (m3)	Harvest Biomass (tons) with density of approx.	
	Diameter (m)	Height (m)		16kg/m3	25kg/m3
P 800*	10	8	800	13	20
2.000	16	8	2.000	32	50
2.600	16	11	2.600	42	65
MS 2600	16	10	2.600	42	65
3200	20	8	3.200	51	80
4200	20	11	4.200	67	105
MS 4000	20	10	4.000	64	100
6000	24	10	6.000	96	150
8400	24	15	8.400	134	210
12000	28	16	12.000	192	300

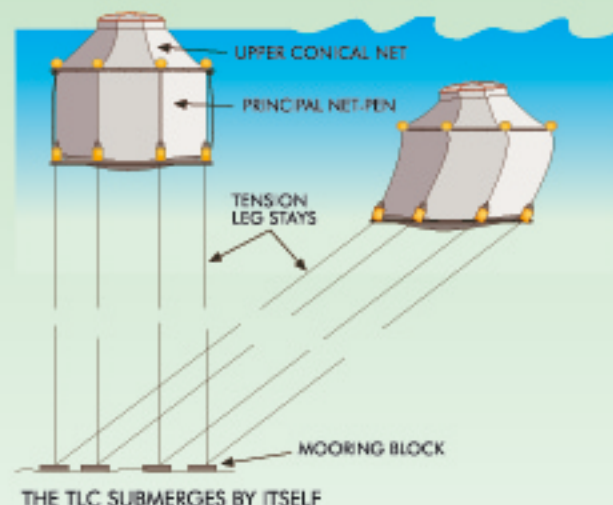
*Nursery Cage

TLC - Tension Leg Cage
Proven performance in extreme conditions

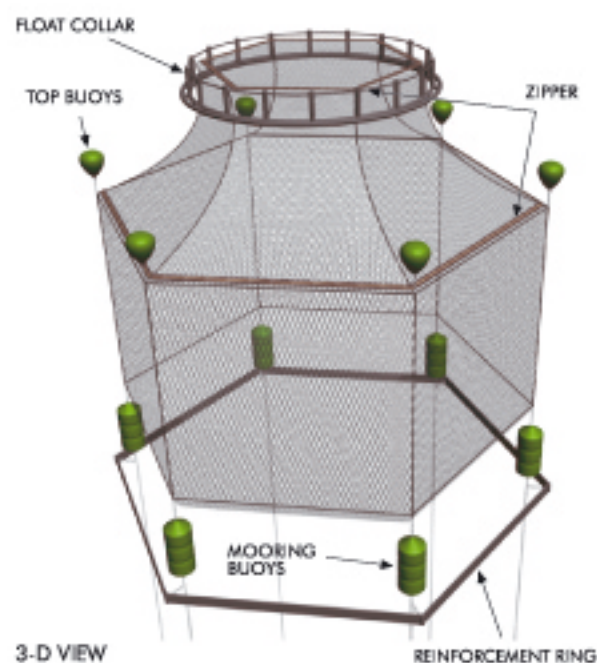


**Fish Farming Technology
for the Open Seas**

Refa Tension Leg Cage



TLC SUBMERGED



The Tension Leg Cage (TLC) concept is based on the dispersion of wave energy in the sea.

With increasing depth the waves are sequentially filtered; the sea is virtually calm at a depth corresponding to half the wavelength.

The TLC cage is flexible and small in the upper section where the waves hit hardest, while its supporting structure is positioned at depth. In storm conditions the cage does not oppose the marine forces, but moves in synergy with the waves almost like seaweed, thus minimizing the strains on all cage components.

The TLC cage has been developed together with Maritek – Sintef Institute, and is patented worldwide.

TRADITIONAL CAGES

With conventional cages, the buoyancy is concentrated at the surface. The net-pen and associated weights are supported by the flotation collar on which the wind, current and wave forces all act. The floating collar and respective moorings are thus subjected to violent stress, while the net-pen deforms. In high currents the net-pen can be compressed to below 30% of its original volume, while the fish are confined to the severe sea surface conditions, resulting in damage and mortality.

TLC CAGE SYSTEM

The principal net-pen of the TLC remains stable under all conditions, retaining its volume, without any violent motion, thanks also to the effective anti-fouling treatment of the net. This ensures a stress-free environment for the fish which continue feeding and growing, without any breaks in production. TLC farms can be sited at considerable depths. The vertical moorings occupy only the area of the net-pen and do not interfere with navigation, fishing or tourism interests. Each cage forms an independent unit. A TLC facility, moorings included, will require an installation area at least 10 times smaller than a facility with conventional cages. The cages can be installed over irregular and steep sea-floors, with mooring lines shorter than the sea depth.

TLC CONSTRUCTION

The TLC consists of:

- the mooring module (clump weights, tension legs, mooring buoys, reinforcement ring) and
 - the cage-net module (net-pen, top buoys, float collar).
- The mooring module is permanently installed, while the cage-net module can be released to the surface for fish handling, towage, etc., just like any surface cage.

The net-pen consists of a lower cylindrical part (principal net-pen) and an upper conical part. These are jointed with heavy-duty zippers, for fast and convenient removal.

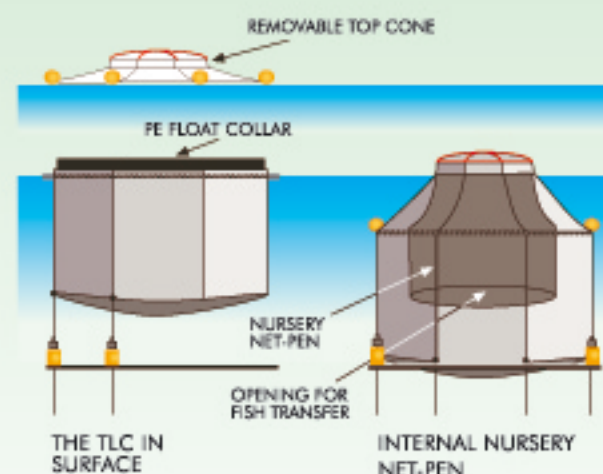


SEAWORTHINESS

In storm conditions and currents of about 1 knot the TLC submerges by itself, retaining over 90% of the net-pen volume. With currents up to 3 knots the principal net-pen is not subject to any appreciable volume reduction.

TLC's unique construction allows farming where intermittent currents make the use of traditional equipment impossible. TLCs are operating on sites exposed to 7000 km of open-sea fetch, and waves over 10 m high.

The success of commercial farms in the Mediterranean and Atlantic confirms the validity of our TLC technology



OPERATING WITH THE TLC

The knowledge, matured with traditional fish farming cages, is applied to the management of TLC farms.

Fingerlings can be transferred directly from a truck to the TLC cage-net module in surface position. This is then towed to site and fixed to the cage mooring module.

An internal nursery net-pen is available for stocking small fry. It is equipped with a bottom opening for gentle subsequent transfer of fish into the principal net.

The anti-fouled net-pen does not require changing for periods up to 18 months. If required, the net of a TLC can be easily changed after bringing the cage to the surface. Fish is harvested utilizing a "double-bottom" net panel. Alternatively, the net-pen is raised to the surface and attached to a PE float collar. The upper conical net is removed, and the fish are harvested with sweep-nets on site or at port. The lowering and release of the cage-net module is a quick process easily performed with a small farm boat.



TRANSFER OF FINGERLINGS

FEEDING

A Feed Buoy has been specifically developed as a simple and rational solution for automatic feeding of 4 TLC-cage module. Feed barges with high storage capacities are employed for large farms.

Both automatic and manual feeding regimes are employed, in function of the number of cages, distance from shore, labour and investment costs.



INSIDE THE TLC

DURABILITY

The components of the TLC are manufactured and tested to resist open-sea conditions with an ample safety margin. Maintenance requirements are minimal since the structure is not subjected to the extreme forces at the sea surface. The elements of the cage are easy to transport, and do not require heavy lifting equipment nor special machinery for assembly and installation. The TLC can be installed on remote sites, with low overall costs.

Every cage component can be substituted easily, without disrupting regular farm husbandry.

The TLC is seaworthy, easy to operate and maintain, simple to install, and requires limited investment... the ideal solution for today's open-sea fish-farms.

REFA MED is the off-spring of the REFA Group and MARAQUA Ltd, blending Norwegian fish-farming technology and international know-how for modern, cost-efficient off-shore facilities.



We deliver turn-key farms, innovative cage systems, feeding solutions, work-boats and all equipment to meet the operational requirements of each project, including design, training, start-up and management services.



ANTI-FOULING IMPREGNATION



NET-PEN ASSEMBLY FROM OWN NETTING



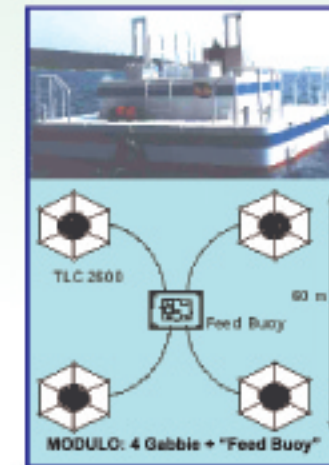
POLYETHYLENE CAGES



SHELTERED CAGE FARM



AUTONOMOUS OFFSHORE FARM



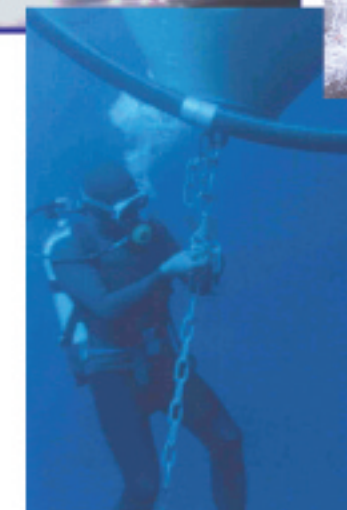
TLC MODULE: 4 CAGES & FEED-BUOY



HARVESTING



RIDING THE WAVES



INSTALLATION WORKS



WORK-BOATS



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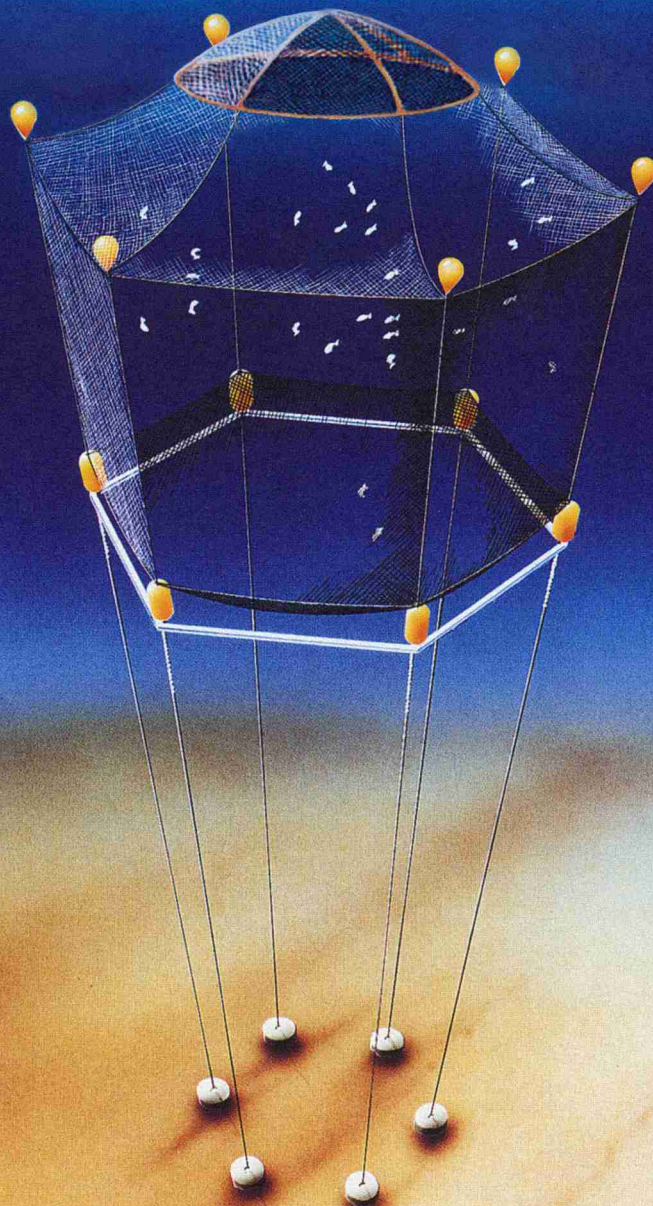
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Submerged TLC



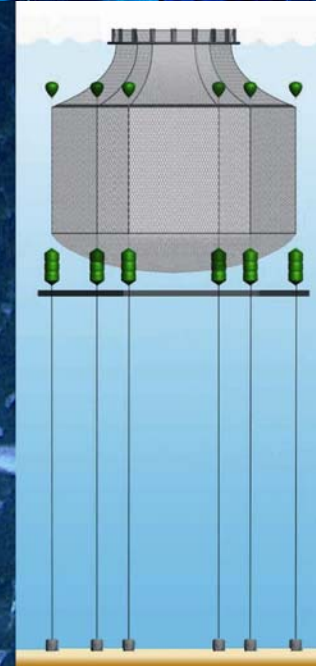
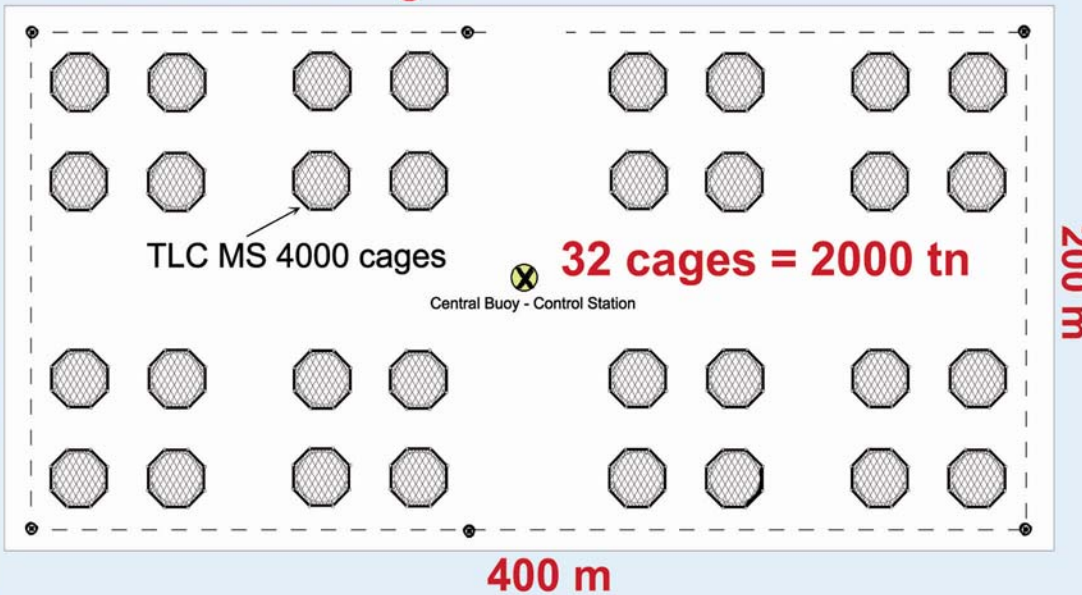
Based on the proven Tension Leg Cage design
for specific site & species requirements

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The Tension Leg Cage occupies a minimal area since its moorings do not extend laterally.

TLC MS 4000 cages



Each TLC cage is an independent, freely-moving unit, with no connection to neighbouring cages.

At 55 m depth, 8 PE cages + moorings require 440.000 m², TLC area remains the same.

At 35 m depth, 8 PE cages + moorings occupy 400 m x 600 m = 240.000 m² area.

In the same space we can install 96 TLC

PE Cages & Mooring at 35 m depth

