Oil Recovery Rate Comparison

EST 60m Offshore *Oil Spill* Barge

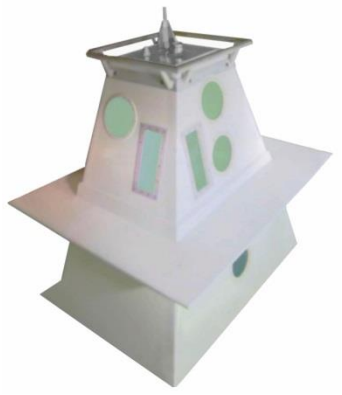
&

CNOOC *Oil Spill* Platform Supply Vessels 255/256

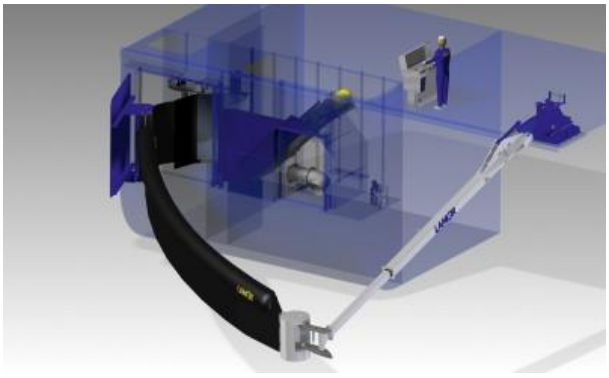
EST Oil Spill Barge

CNOOC Oil Spill PSV

Oil Recovery Technology



EST Tower System (8 units)



Lamor LORS (2 units)

Immediately after an accident, when a large volume of oil is spilled on the water, the oil can be quite thick, especially heavy oil like Bunker C. With time, the oil spreads and becomes a thin layer. In many oil spill accidents the responders are dealing with thin layer of oil, often less than 1 mm thick, because the Tiered oil response system, the industry standard everywhere, allows 72 hours to respond to a spill. The oil has usually spread far and wide and become a very thin layer floating on the water. Under these conditions, the CNOOC PSV can cope:

Oil thickness: 1mm

Amount of oil encountered in 1 hour is the surface area cleaned in m2 x thickness of oil in metres.

	EST Barge	**CNOOC PSV**
Ocean Surface Cleaning Rate	140K m2/hour	144K m2/hour
Amount of oil encountered in 1 hour	140 m3	144 m3
Rated Oil Pumping Capacity	4480 m3 / hour***	200 m3 / hour
Amount of oil successfully recovered	140 m3 / hour	144 m3 / hour

When the oil encountered is 1mm thick, or less, the CNOOC PSV has no problem pumping all the encountered oil to storage. It encounteres 144 m3 and can pump 200 m3.

However, when the oil is freshly spilled, it may well be 25mm thicker or even thicker. Then the CNOOC PSV has a problem. It will encounter the oil but it won't be able to remove it from the ocean. The EST oil spill barge does not have this problem. Of course, in a thick oil spill, the EST pumps will pump directly to another vessel alongside or transfer regularly to a nearby tanker or barge. Only the EST oil spill barge can successfully clean up a large spill because it has the pumping capacity. When the X-Prize contest was performed at Ohmsett in 2012 they used oil that was 25mm thick. http://www.iprizecleanoceans.org/ The X-Prize technology does not work in waves.

Oil thickness: 25mm

	EST Barge	**CNOOC PSV**
Ocean Surface Cleaning Rate	140K m2/hour	144K m2/hour
Amount of oil encountered in 1 hour	5600 m3	5760 m3
Rated Oil Pumping Capacity	4480 m3 / hour***	200 m3 /hour
Amount of oil successfully recovered	4480 m3 / hour	200 m3 / hour

Features	EST Barge	CNOOC PSV
Total Price (vessel + oil recovery system)	50 Million RMB	480 Million RMB
Modular, Removable Oil Spill System	Yes	No
Multipurpose Vessel	Yes	Yes
Transit Speed	10 kt*	12 Kt
Oil Recovery Speed	1-3kt**	1-2 kt
Width of Swept Path	26m	40m
Ocean Surface Cleaning Rate	140K m2/hour	144K m2/hour
Automated Oil Pumping System	Yes	No
Rated Oil Pumping Capacity	4480 m3 / hour***	200 m3 /hour
Oil Viscosity Capability With Steam Injection	3,000,000 CST	3,000,000 CST
Oil Encounter Rate Limitations	None	> 0.1mm
Sheen Recovery Ability	Excellent	None
Oil Accumulation System	Sealed****	Open
Simple to Operate and Maintain	Yes	No
Ice Capability to Recover Oil Effectively	3m Arctic, Solid*****	Zero
Nitrogen Gas Safety System (oil tanks)	Yes	Yes
Onboard Recovered Oil Storage	1,500 m3	655 m3
General Cargo Capacity	3,000 tonnes	Unknown
Effective Oil Recovery Capability_Beaufort	Force 6-7******	Force 4
Maximum Wave Height For Effective Work	4-5m	1.2m
Oil Tracking Radar	Sigma X6	Sea Darq

http://www.rutter.ca/sigma_s6_oil_spill_response/
http://www.seadarq.com/seadarq?set_language=en

Features	EST Barge	CNOOC PSV
Recovery Efficiency (Oil/Water)	95%	85%
Throughput Efficiency (Oil/Water)	94%	92%
Firefighting Capability (Water)	4480 m3 / hour	Unknown
Width of Oil/Debris Capturing System	26m	1m
Dispersant Spray System	15 m3/hour_4m3 tank	15 m3/hour_4m3 tank

- The EST oil spill barge in transit mode is a catamaran that offers low resistance

** Lamor claims an oil recovery speed as high as 4 kts. Their videos and the photograph in Appendix One clearly show the turbulence at higher speeds. At these higher speeds, they do not show their system recovering oil because the oil would become entrained and escape under the boom. Floating booms can only be towed at 1 kt before entrainment occurs, and the Lamor system uses floating boom.

http://www.lamor.com/products/skimmer-systems-large/lamor-built-in-oil-recovery-system-lors/

*** The EST 60 oil recovery barge utilizes 8 EST oil recovery towers. Each tower can be equipped with a variety of types of positive displacement pumps. One configuration is to have 4 FoilexTDS 250 pumps mounted on each tower. Since each pump is rated for 140 m3/hour, the total rated pumping capacity is 4480 m3/hour (32 pumps x 140 m3/hour).

**** In the EST system, the trapped oil accumulates in the sealed tower. At this point the oil is still outside the vessel and the crew are not exposed to toxic oil and fumes like they are with the Lamor system. A further benefit of the EST system is no free surface effect.

***** The EST barge can handle the heaviest, solid pack ice, including flowing ice. There is nothing to break. Ice will quickly plug and destroy the fragile Lamor LORS.

****** All conventional oil spill technology, including Lamor, can only operate in wind and sea conditions up to Beaufort Force 4 even though they claim they can operate in 3m waves. The maximum wave height they can operate in is about 1.2m. BP's DWH spill demonstrated this fact very clearly. This greatly limits their effectiveness on the ocean. The EST 60m oil recovery barge can work effectively in Force 6-7 because of its unique features which include:

- No floating boom
- No fragile moving parts which are a target for waves
- No free surface effect
- No waves *under* the EST vessel which is where the oil recovery activity takes place
- *Very large size* to subdue the waves and minimize vessel motion and turbulence

CNOOC _ Force 4

Mean Wind Speed 13 kts

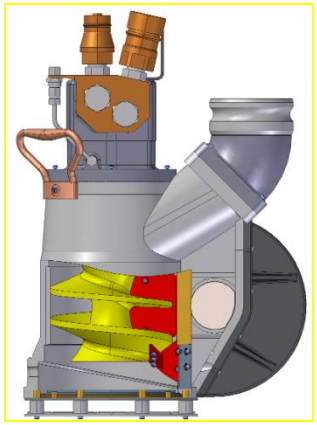
Probable Wave Height 1m

EST_ Force 6

Mean Wind Speed 24 kt

Probable Wave Height 3m

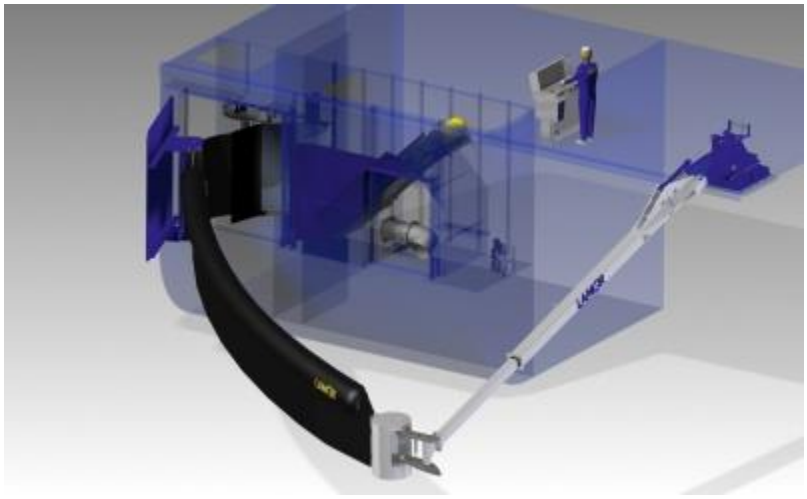
Note: The EST 60m oil spill/multipurpose barge can be built larger if more capability at sea is required. An EST oil spill barge can be pushed effectively by a tug or PSV. The barge can be permanently stationed at an offshore oil field and serve as command headquarters for spills, emergency accommodations in the event of a rig evacuation, firefighting unit (huge water pumping capability), warehouse etc. It can easily accommodate a helipad and hangars.



Appendix One

The Lamor LORS

Note the extreme turbulence at 3-4 kts



Technical Specifications

(Prod. code # 01C03)

LORS	4C	5C
Length, mm	2500–4500	3500–5000
Width, mm	1000	1500
Height, mm	2000	2000–3000
Weight, system kg	2500	3000
Power requirement skimmer only, kW	10	10
Certified capacity, m^3/h	203*	260*
Free water content	<5%	<5%
Recovery speed	1 - 4 knots	1 - 4 knots
Hydraulic flow skimmer only, l/min	20-40	20-40
Hydraulic pressure, bar	210	210

*Capacity related to pump selection

Features & Benefits

- Safe, fast and easy deployment
- Operating speed up to 4 knots
- Very high oil encounter rate
- High recovery efficiency in all conditions
- Effective in choppy waves without collecting excessive amounts of water
- Recovery of all types of oils up to the highest viscous oils and emulsions
- Excellent ice, debris and seaweed handling capability
- Simple and reliable operation