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TEXAS SNAME

EnerSea
TRANSPORT L.L.C.

Designing Ships for an Innovative Gas Transport Industry

"K" LINE
KAWASAKI KISEN KAISHA, LTD.

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

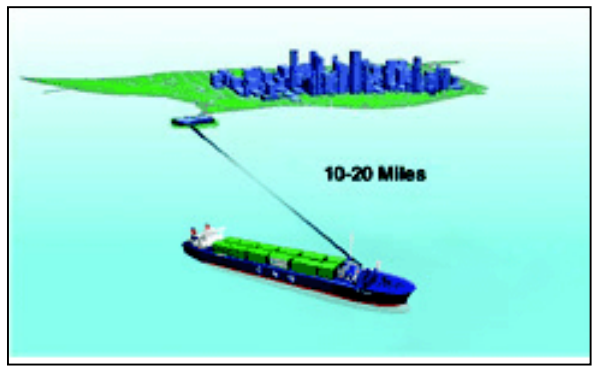
11 November 2003

Energy Priorities
Drive Regulatory Acceptance

U.S. Maritime Transport Security Act of 2002

Promotes transportation and delivery of CNG to Offshore Gas Ports

- ✓ USCG developing rules for Offshore Gas Ports [2 port applications under review]
- ✓ NPC Natural Gas Study – CNG supply



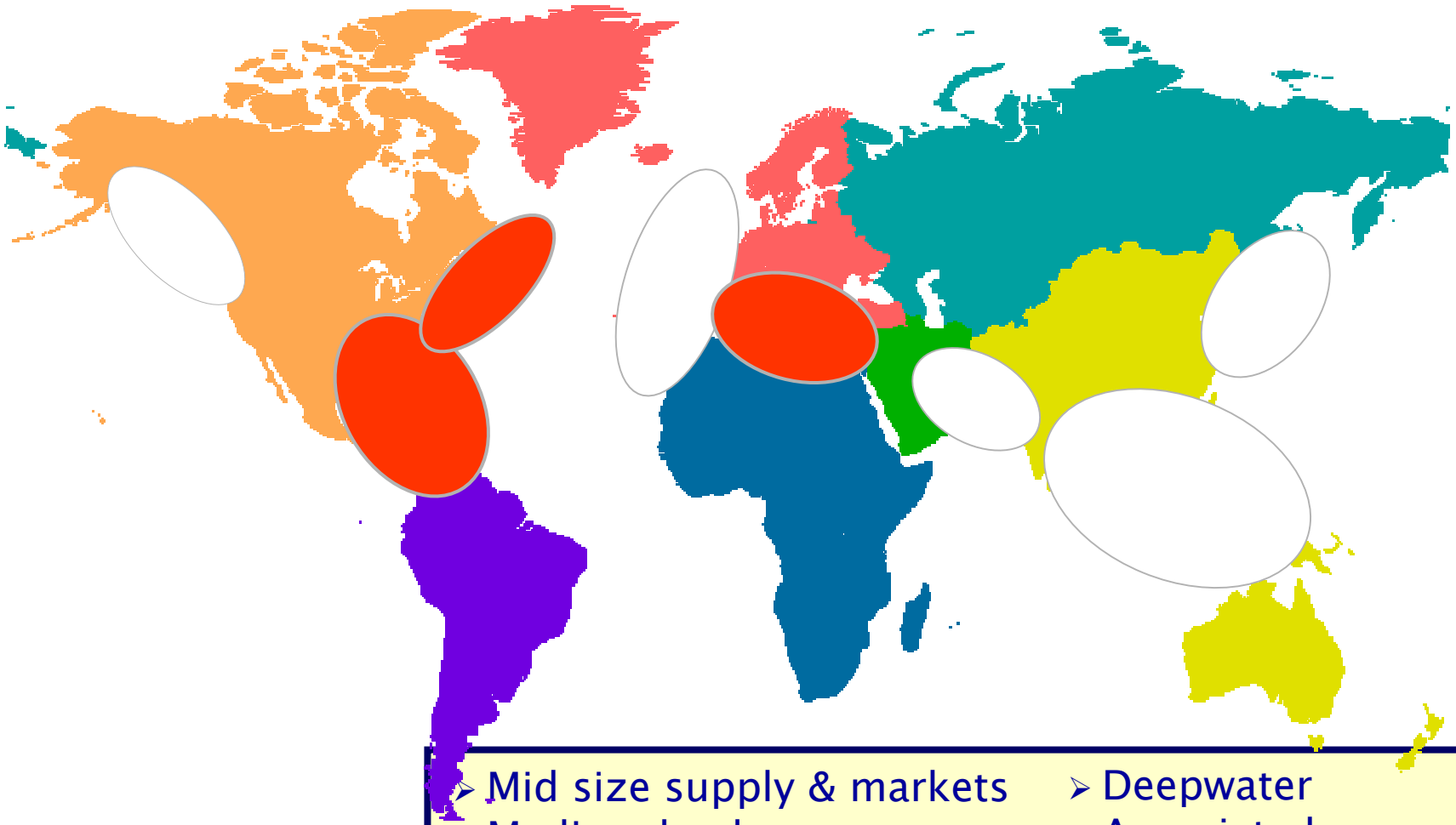
Increased security and access

- ✓ MMS/Industry performing DWGOM stranded gas study

- ✓ USCG Concept Review process – started

Global Applications

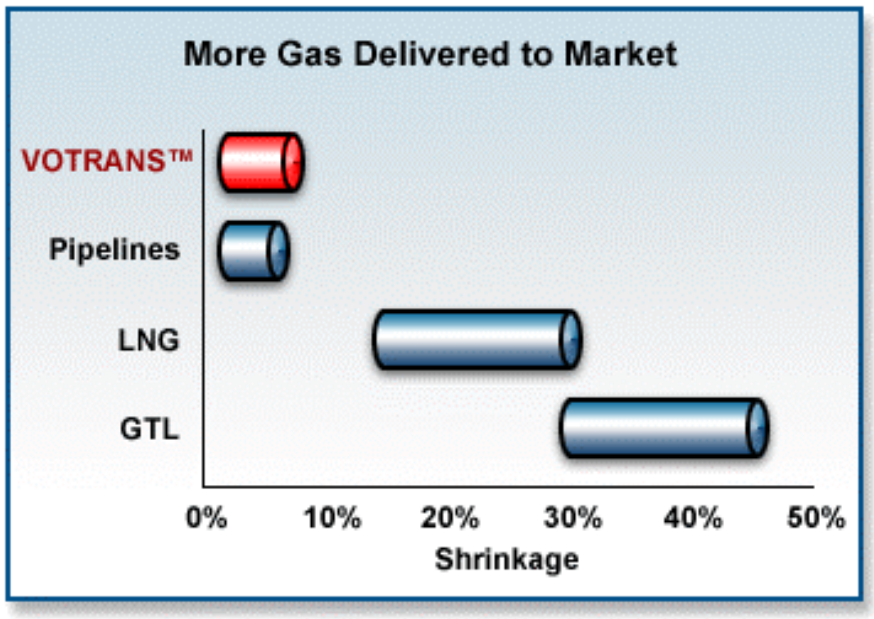
The World Needs CNG



- Mid size supply & markets
- Medium haul
- Dynamic supply sources
- Emerging gas economies
- Deepwater
- Associated gas
- Risky areas
- Fast track projects

CNG – A conscientious decision

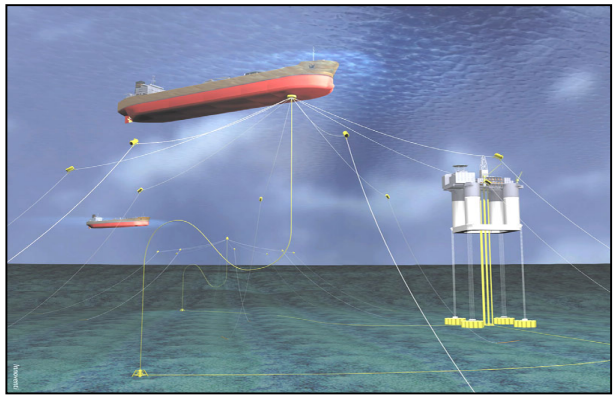
Conserving Resources



- Less Waste
- Lower Emissions

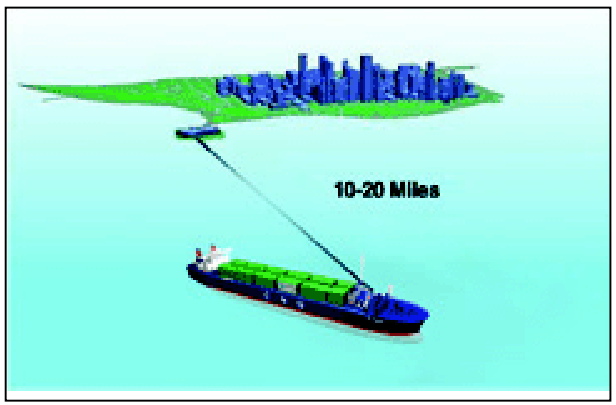
Gas Re-injection/Recycling while waiting for a pipeline will incur additional losses of at least 5%

VOTRANS System Overview
Complete Gas Delivery System



- Loading Facilities
  - Subsea flowline
  - Flexible riser
  - Loading buoy(s)

- VOTRANS Vessels
  - Chilling
  - Containment
  - Gas handling

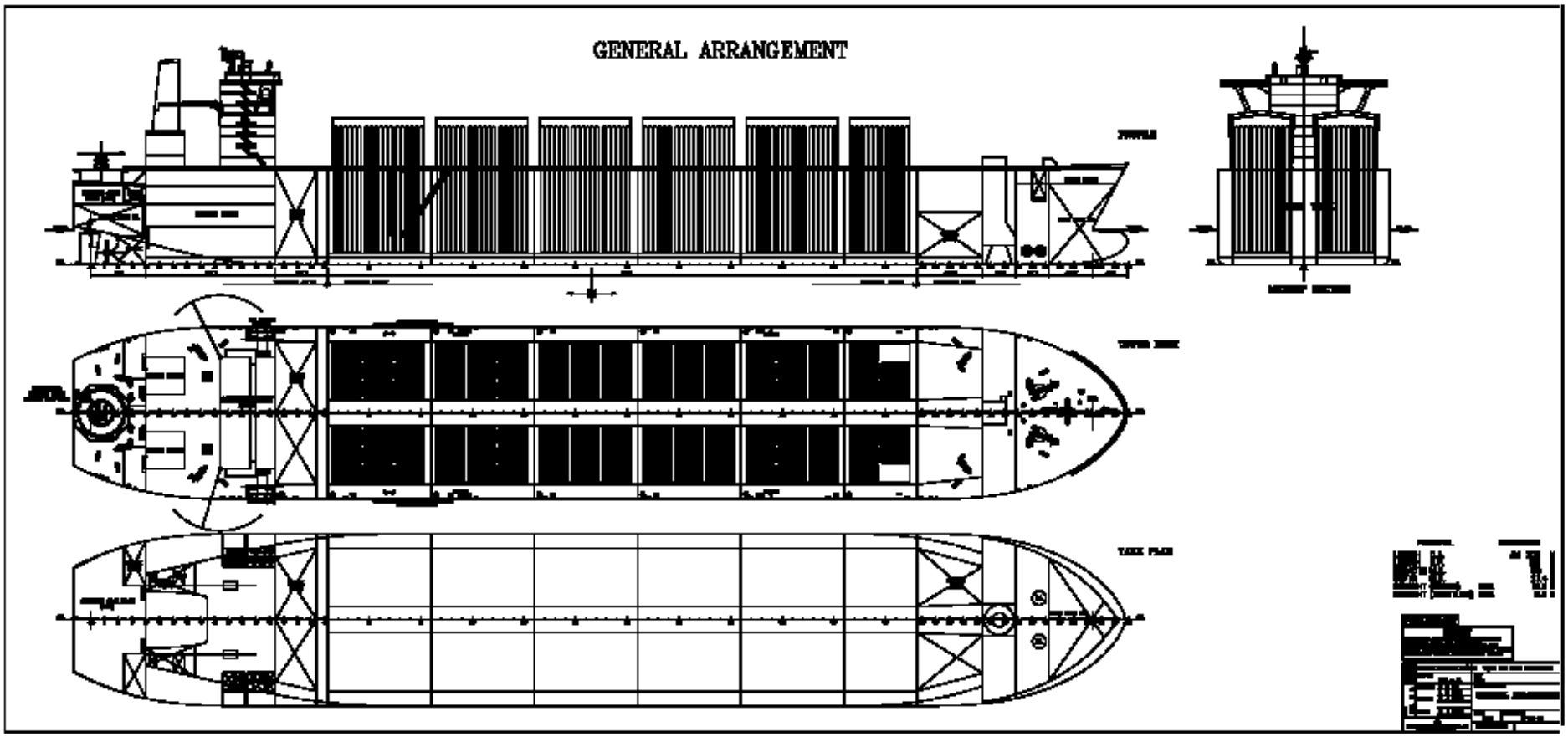


- Delivery Facilities
  - Offloading buoy
  - Riser
  - Subsea flowline
  - VOLANDS Storage

EnerSea's Volume-Optimized CNG Technology
What is different?

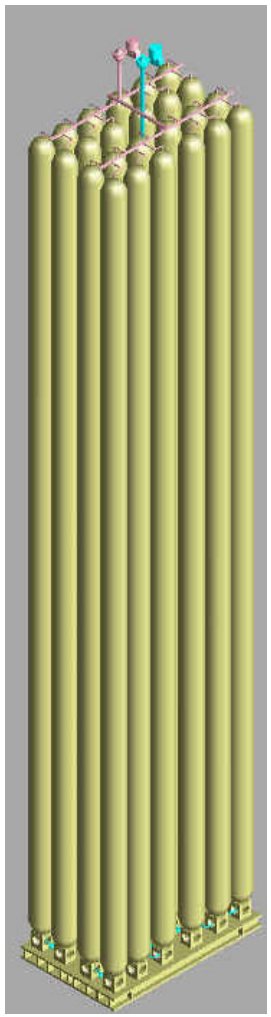
- **Proprietary gas storage optimization:**
  - Optimize pressures & temperatures
  - Half the storage pressure *(<1900psi v. 3000-3600 psi)*
  - Lower steel weight
- **Low cost, widely available materials:**
  - Straight, High-Strength carbon steel pipe
  - No exotic materials
  - Proven fabrication and construction techniques
- **Proprietary gas handling technology:**
  - Supports transport of rich/associated gas
  - Very low residual, or 'heel', volume (±1% vs. 6-10%)
  - Manages pressure & temperature dynamics

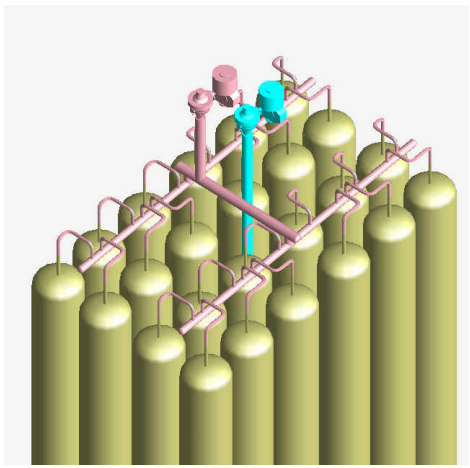
Constructible Design
General Arrangement

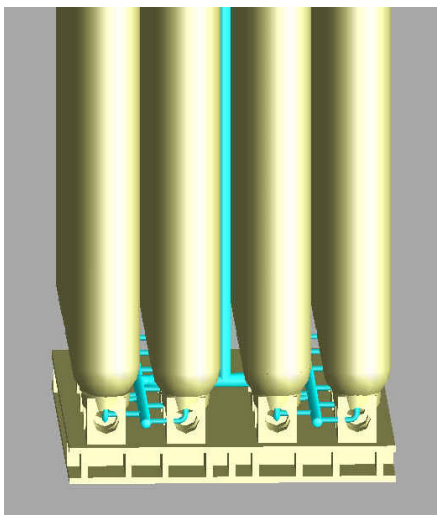


Length, LOA	306.0 m	Full load draft	10.2 m
Beam, B	50.0 m	Lightship draft	7.5 m
		Ship Speed	18 knots

Segregated Storage
Pipe Tank Modules







Top and Bottom Manifolds allow complete evacuation of cargo

Gas Volume:	700 MMscf (20 MMscm)
Operating Temp:	−20 °C
Operating Press:	<130 bar
Tank Height:	36 m
Pipe Tank Module:	24 pipes
Modules per ship:	100

Cylinders can be designed in accordance with ASME Sect VIII Div 3

ABS Approval in Principle

Granted to EnerSea on April 22, 2003

AIP is a process by which ABS determines:

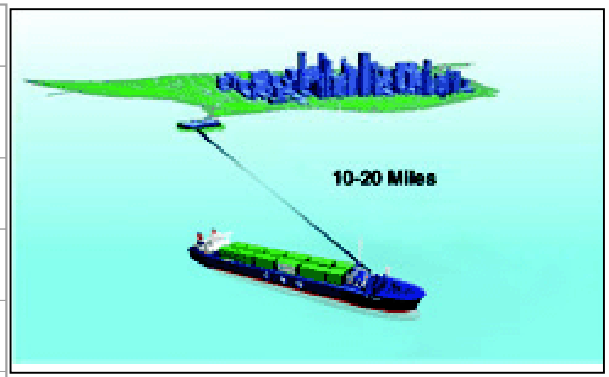
- Novel concept design complies with intent of ABS Rules
- International standards as applicable – IGC code
- The design concept is subject to conditions to be met during final design and project development (including test programs)
- Relies on risk assessment similar to IMO FSA

Provides a "Road Map" for achieving Class

CNG vs. LNG

Comparative Risk Assessment

LNG	CNG
Liquefaction	Compression and Refrigeration
Loading	Loading
Port Departure	Buoy Departure
Transit	Transit
Port Arrival	Buoy Arrival
Discharging	Discharging
Regasification	Decompression



<u>Workshop/Study CONCLUSIONS</u>:

- CNG and LNG have the same order of risk overall
- CNG is found to have a slight risk management advantage, since all risks are kept offshore

New GAS Ship Concept Must be Robust and Safe

VOTRANS development is following IMO 's

Formal Safety Assessment

to prove acceptability under Class rules & the IGC code

- HAZID & HAZOP Assessment
- Comparative Risk Assessment
- Deal with IGC as guide

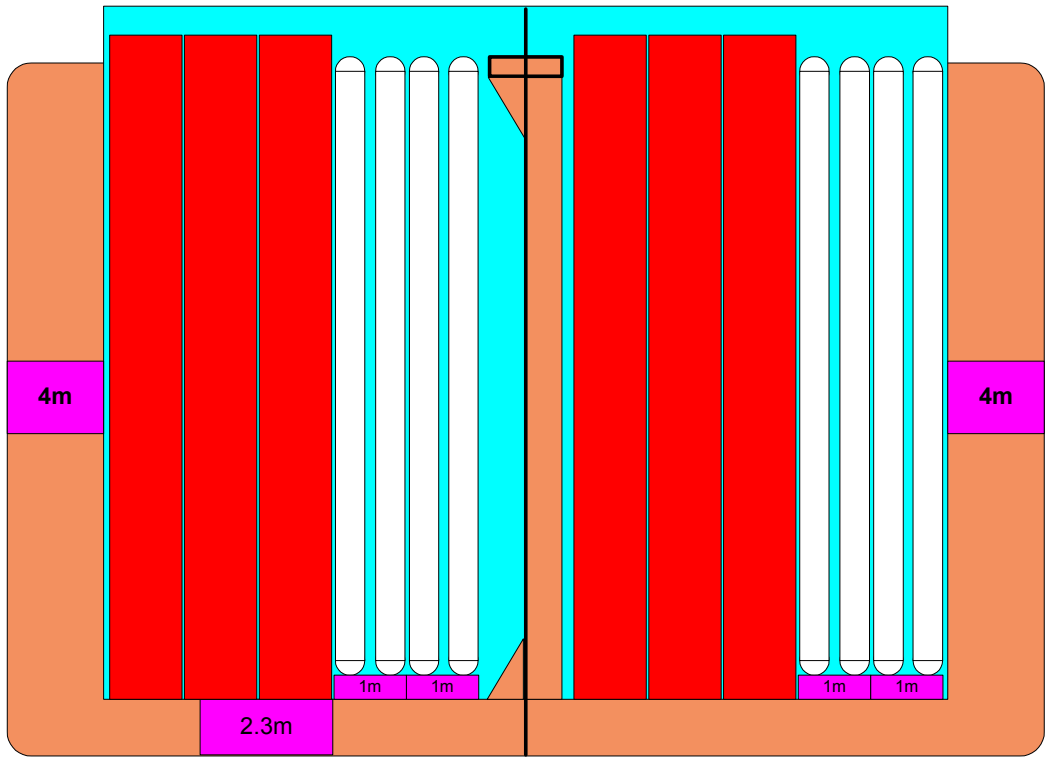
Gas Ship Design Drivers

Driving Factors

- Cargo Capacity
- Cargo Density
- Tank Heights/Weights
- Construction Draft(s)
- Operating Lightship Draft
- Wing Tank widths
- Double-bottom height

Secondary

- *Facilities Payload & Area*
- *Speed*



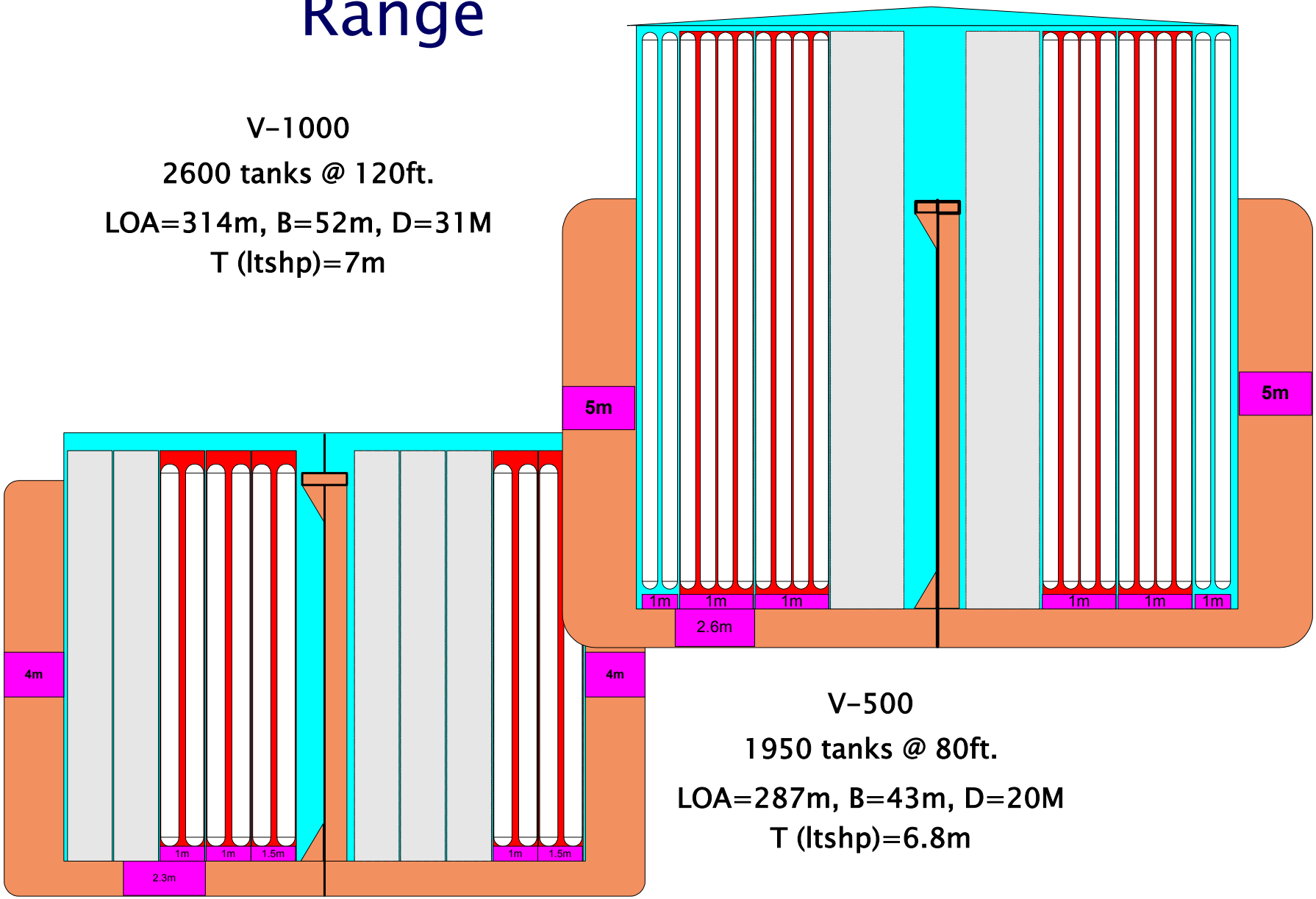
Perspectives on the Size Range

V-1000

2600 tanks @ 120ft.

LOA=314m, B=52m, D=31M

T (ltshp)=7m



V-500

1950 tanks @ 80ft.

LOA=287m, B=43m, D=20M

T (ltshp)=6.8m

Volume-Optimized CNG Carrier Design

Ready for Projects!

- ✓ Legislation has opened the way for US projects
- ✓ International Institute for Marine CNG sanctioned
- ✓ International Design & Delivery Schedule developed with Capital and Operating Costs
- ✓ Approval in Principle by ABS
- ✓ CNG Carrier Rules issued by DNV & pending from ABS classification societies.
- ✓ Jones Act Design Variant (GPSS) in progress
- ✓ USCG Concept Review – in process

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EnerSea TRANSPORT L.L.C.

Innovative EnerSea DW Application

Gas Production Storage and Shuttling Unit (GPSS)

Operator-driven
Commenced Nov. 2003

- "Direct-to-Ship"
- Field operations & production support
- Gas storage
- Gas transport

Eliminates need for expensive deepwater pipelines and other production systems