

American Institute of Marine Underwriters

State of the LNG Industry: A Class Perspective

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New York City

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Overview

- Ship Capacity and Trends
- Technology Update
- Offshore LNG Terminals



LNG Carrier Outlook

LNG Demand

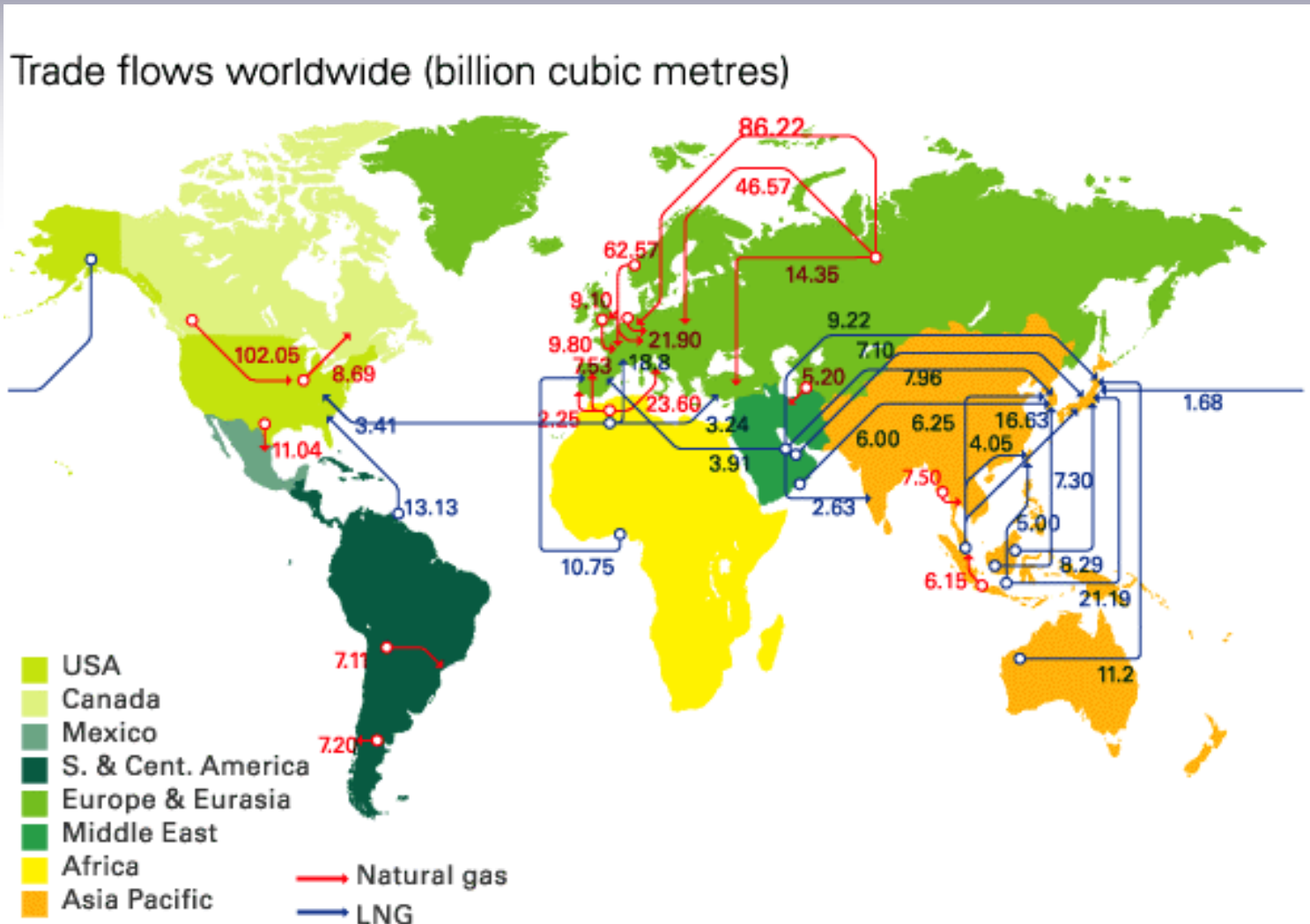
- **LNG** is a major share of the total natural gas currently consumed in several countries, particularly in Asia
- **LNG** imports to the US market are expected to rise significantly, tripling by 2010 and quadrupling by 2015

More ships, more terminals, more LNG

- **LNG** trade is widely forecast to grow by at least 7% per annum over the next decade, almost tripling the quantity traded today
- **Rapid** growth has attracted new entrants
- **Short-term** and spot trades will become increasingly more common
- **Many Offshore** regasification terminals are under consideration



Major Natural Gas Trade Movements



Source: BP Statistical Review of World Energy 2005



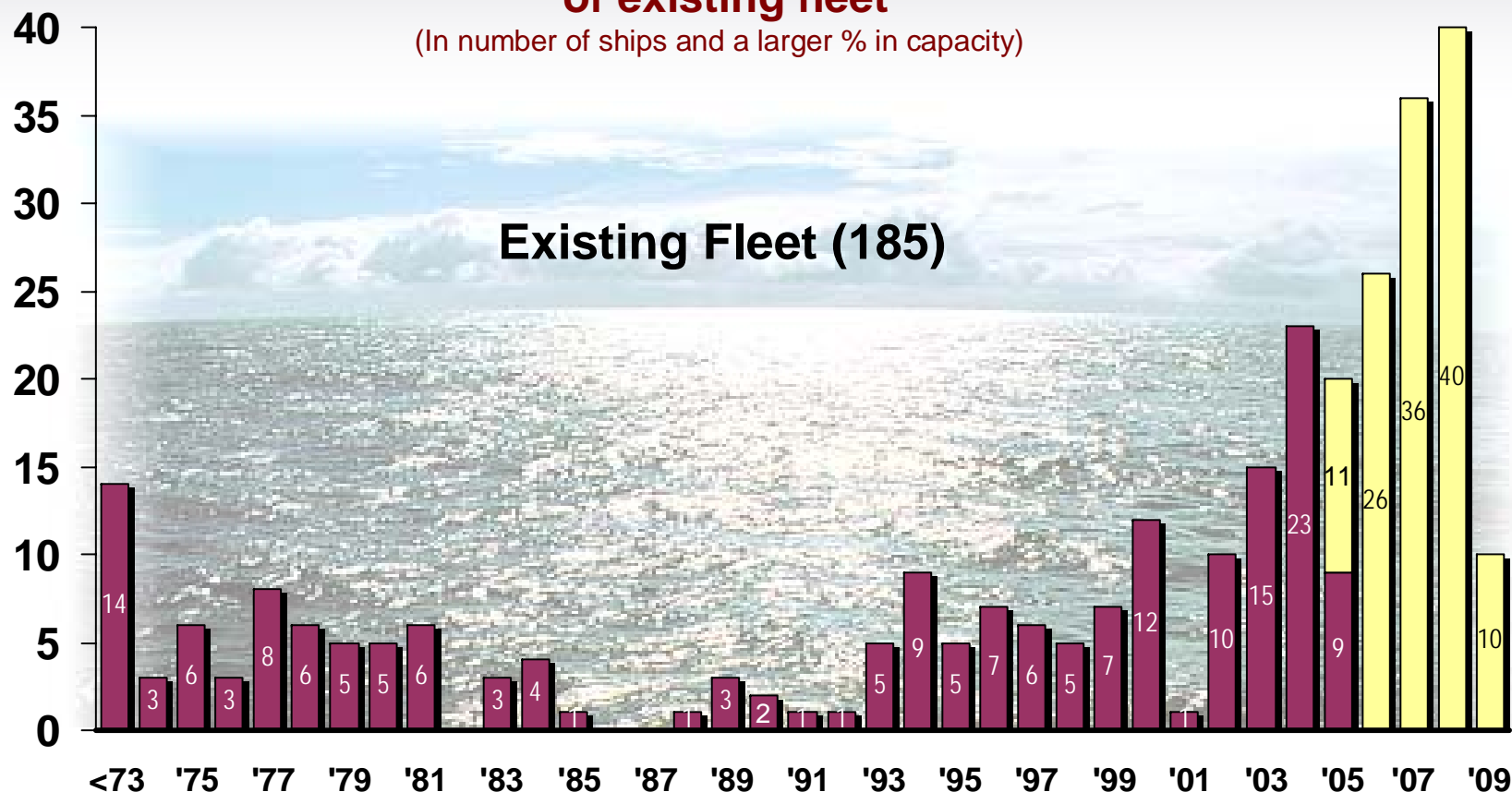
LNG Carrier Fleet

Number of Ships & When Built – September 2005

**September 2005 Orderbook = 66%
of existing fleet**

(In number of ships and a larger % in capacity)

Orderbook (123)
Scheduled delivery



**The significant fleet expansion experience the past few years will
continue at an even higher level**



LNG Order Book Deliveries

(by Shipyard)

	2005	2006	2007	2008	2009	2010
Daewoo S.B.	2	9	8	12	0	0
Samsung S.B.	4	7	9	11	4	0
Hyundai H.I.	1	1	10	7	3	0
Mitsui S.B.	1	0	0	1	0	0
Kawasaki H.I.	2	3	2	3	1	0
Mitsubishi H.I.	1	3	3	4	1	0
Hudong Zhonghua	0	0	1	1	0	0
Izar	0	0	1	0	0	0
De l'Atlantique	0	3	0	0	0	0
Universal S.B.	0	0	1	0	1	0
Koyo Dock K.K.	0	0	1	1	0	0
Total	11	26	36	40	10	0



Annual Capacity Growth - Based on Cubic Meters

Seaborne LNG Trade Outlook

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gas Carrier - LNG	13.0%	15.8%	20.0%	21.3%	13.8%	9.3%	8.0%	7.8%	7.3%	7.2%	7.3%

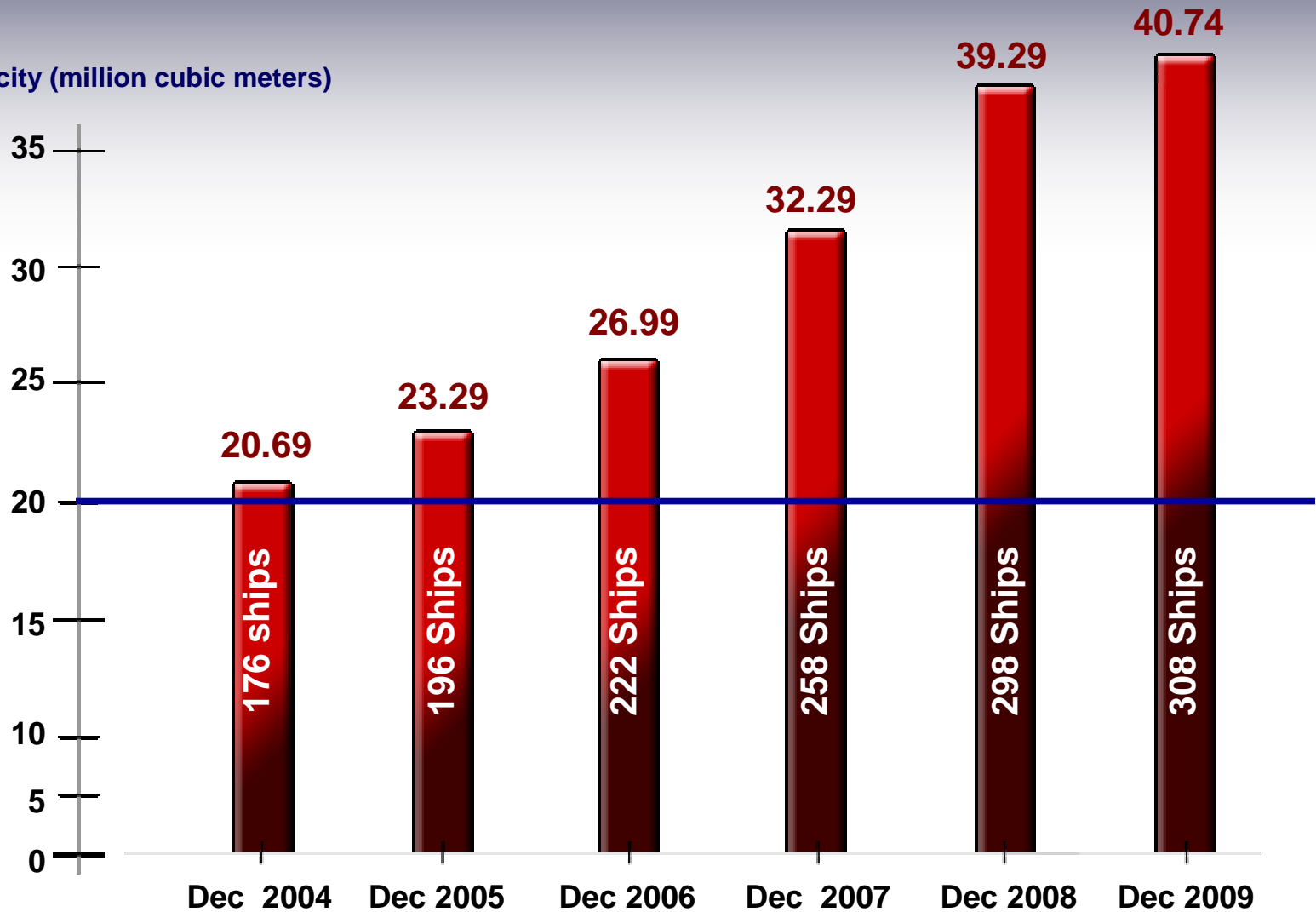
- **Long term** annual trade capacity growth forecast is based on seaborne LNG transport outlook
- **Near term** includes speculative growth, or growth to support new initiatives, both reflected by the current orderbook

LNG trade demand will likely be very strong over the next 10 years, with near term double digit annual growth



LNG Fleet Capacity Growth 86%

Capacity (million cubic meters)



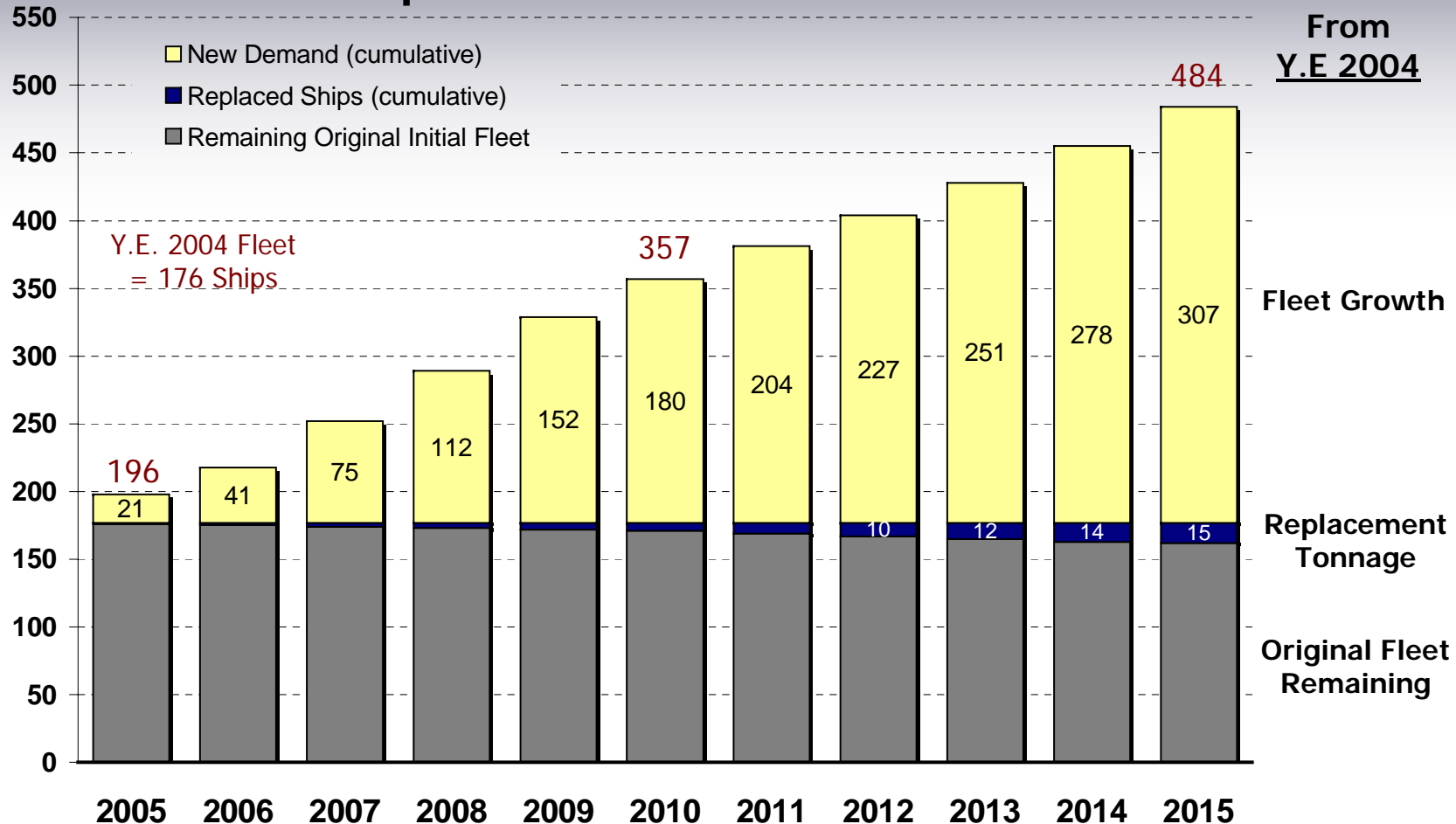
Timeframe

Clarksons – September 2005



LNG Fleet Forecast

Number of ships*- At Year End



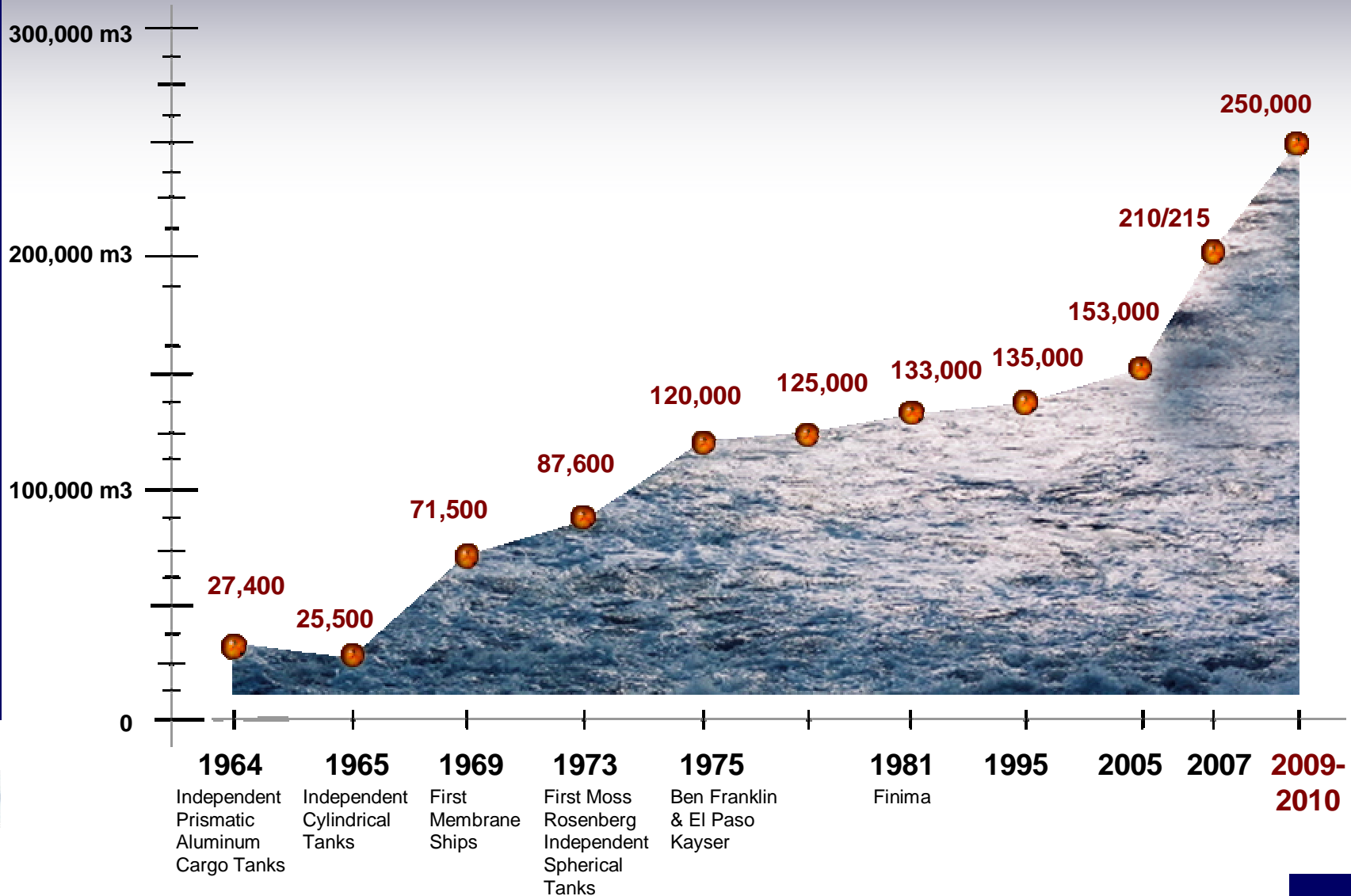
- New Demand will drive newbuilding deliveries
- Replacement tonnage will comprise only a very small share of the total newbuildings

Fleet will double in size by YE 2010 and grow another 35% by YE 2015



Evolution of LNG Carrier Size

Cubic Meters



Larger LNG Carriers

- Technical Considerations
 - Structural Design
 - Terminal Compatibility
 - Propulsion Systems



LNG Transport System Technology

**Next Generation of LNG Ships Require
Advanced Technology that Addresses
the Transport System**

**Propulsion
Technology**

**Containment System
Technology**

**Pump Tower
Analysis**

**Structural Integrity
Technology**

**Ship to Terminal
Interface Technology**



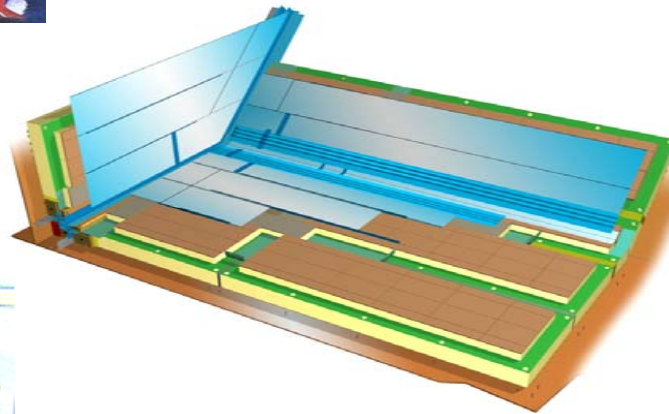
LNG Carriers - Containment Systems



GTT MK III



Kvaerner Moss



GTT CS-1



GTT No 96

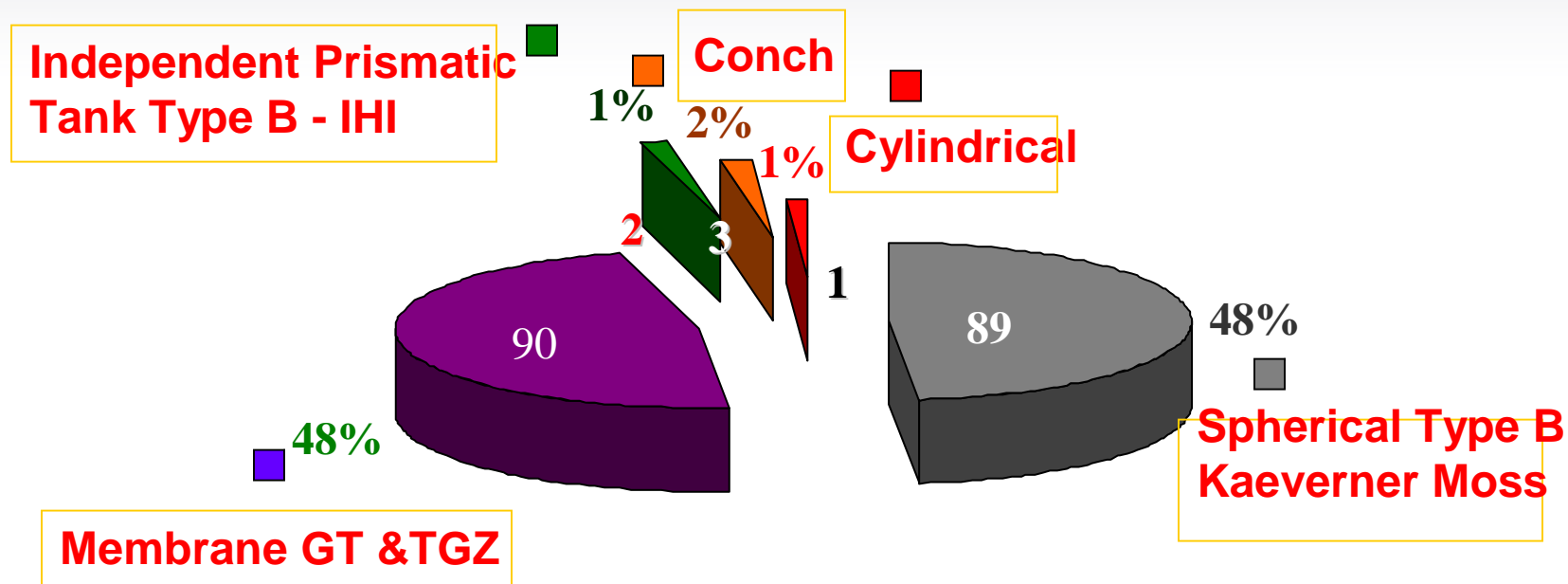


**IHI - Self Supported
IMO Type B (SPB)**



Total World LNG Fleet - Containment

Total Number of LNG ships - 185

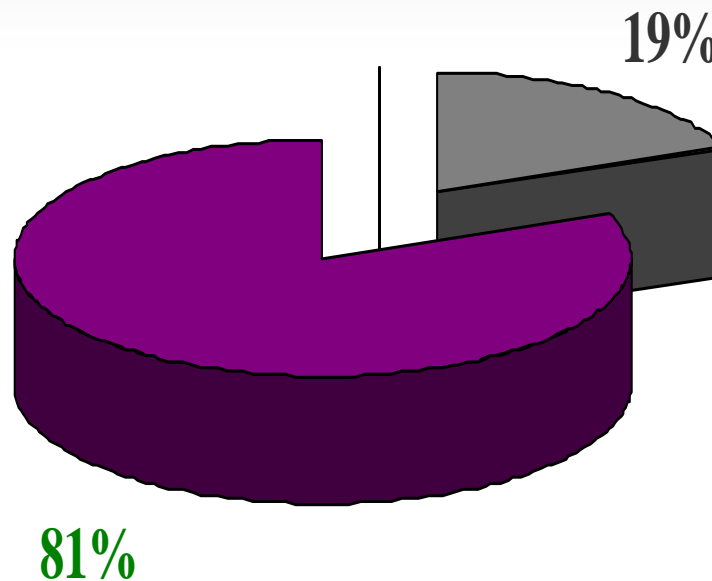


Containment System Distribution



Current Order Book - 123

Moss -23

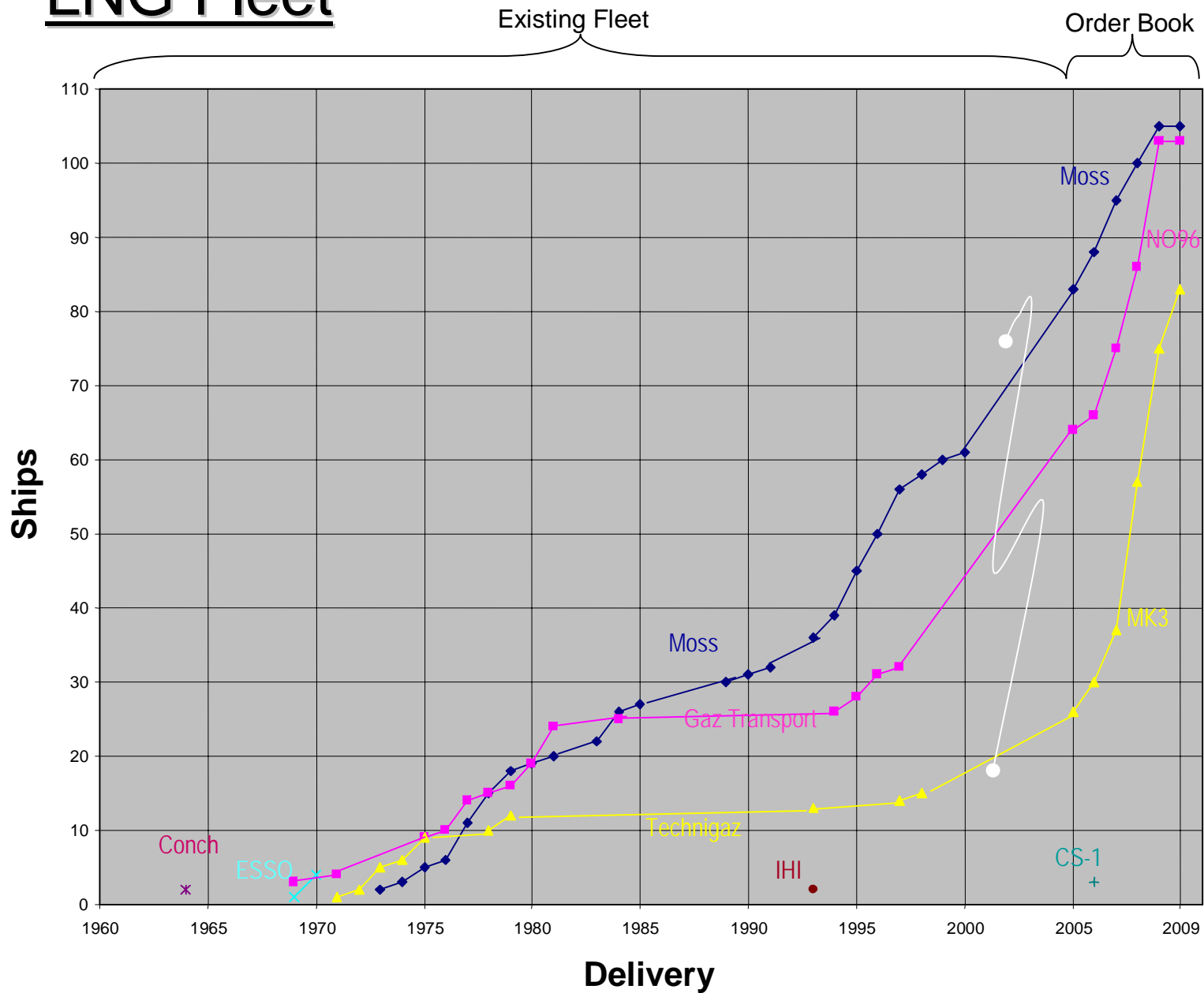


Membrane 100

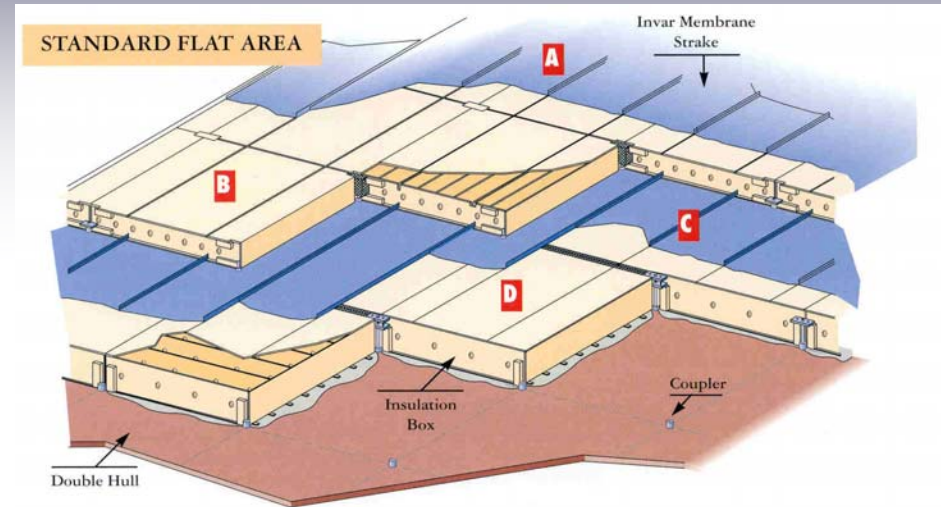
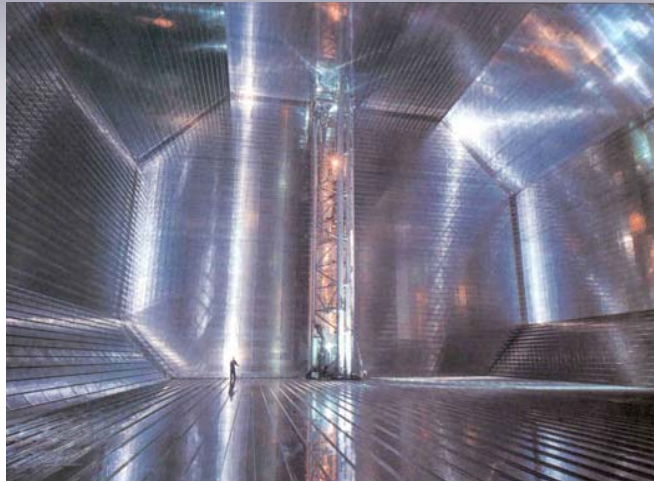
- 41 No 96, - 56 Mk III , - 3 CS-1



LNG Fleet

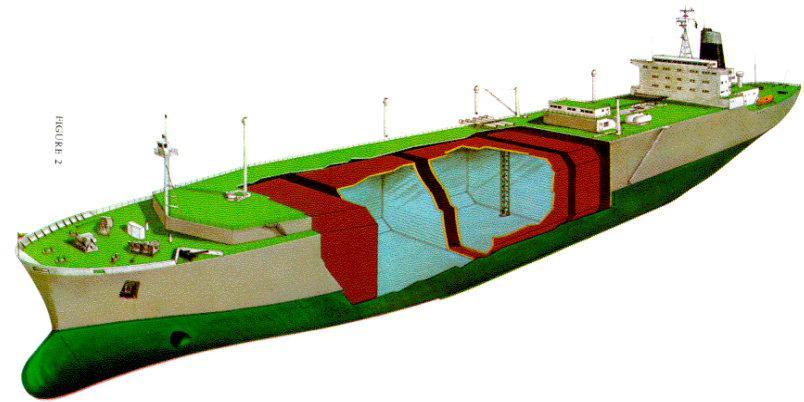
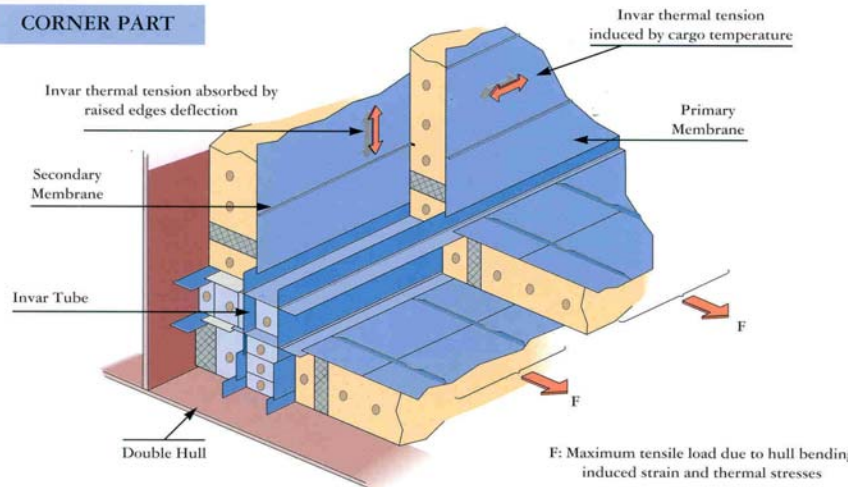


GTT Membrane - No 96 Containment System

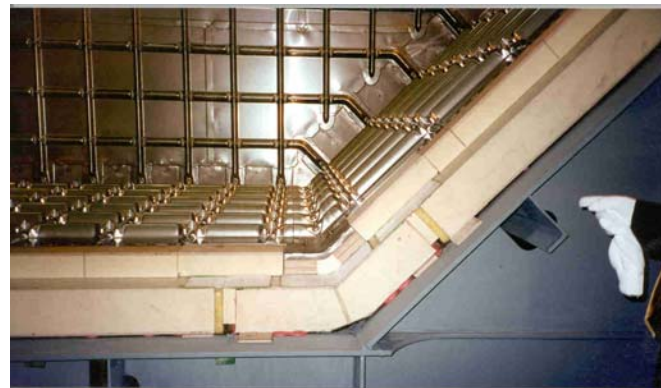
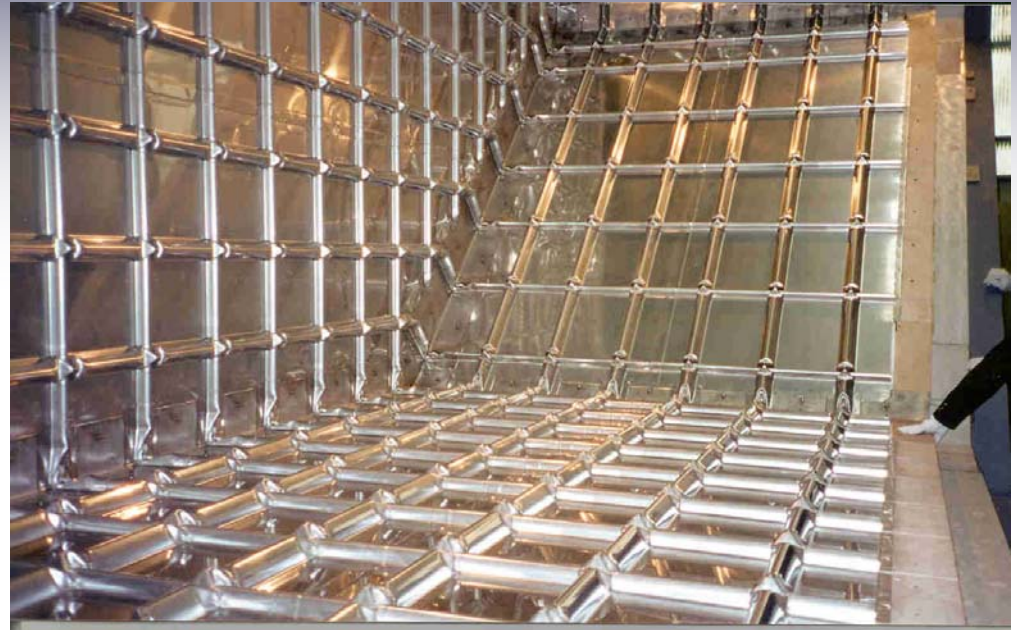


— GAS TRANSPORT —

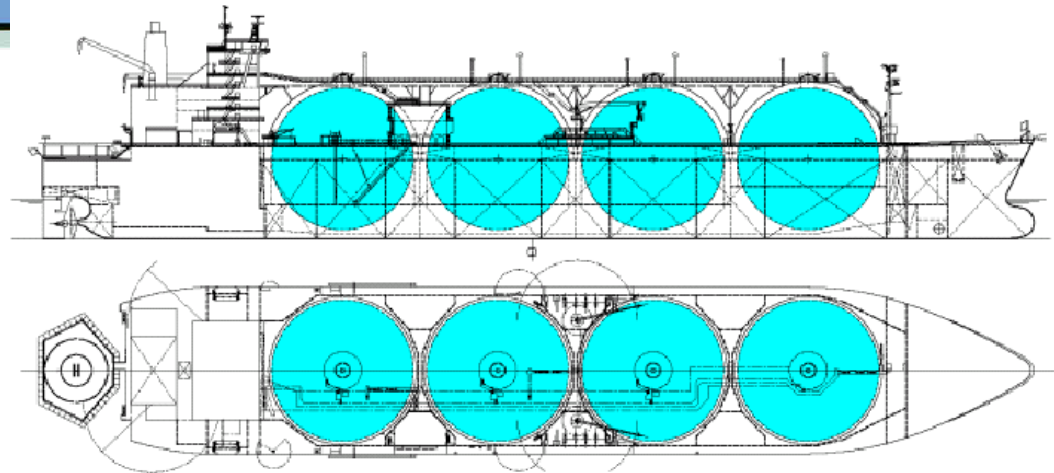
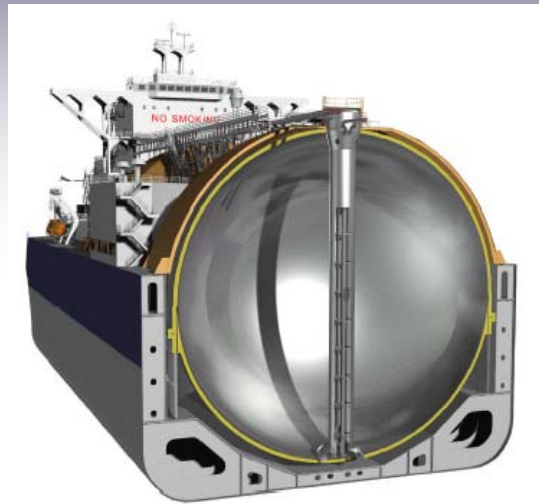
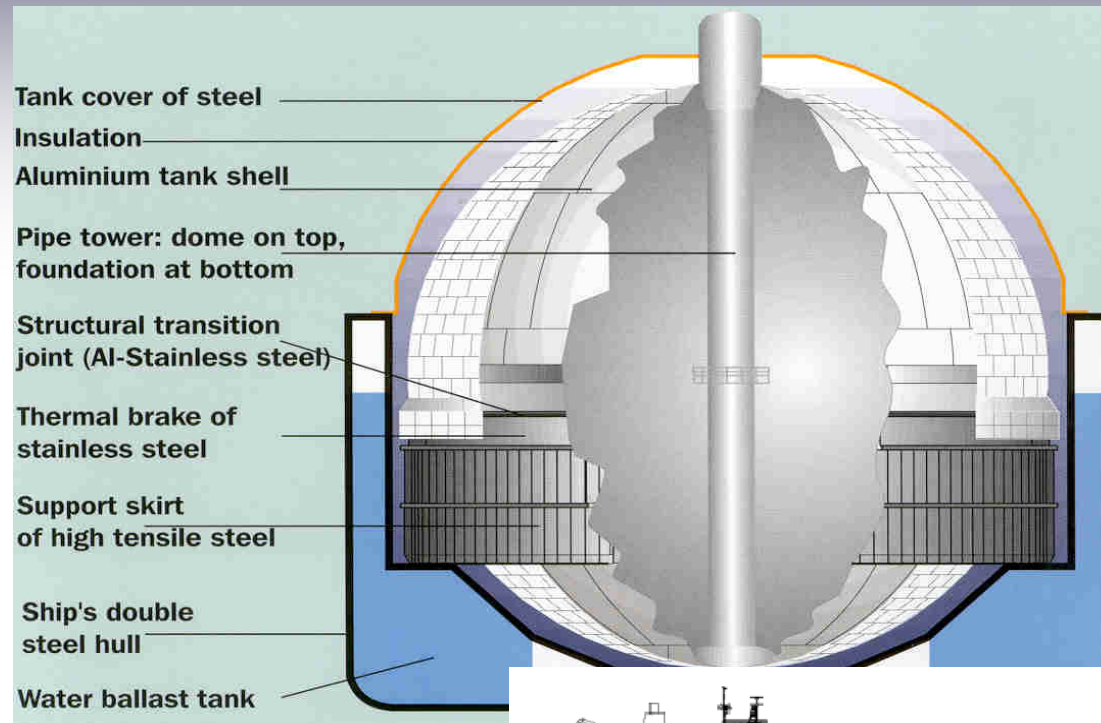
CORNER PART



GTT MK III - Membrane Design

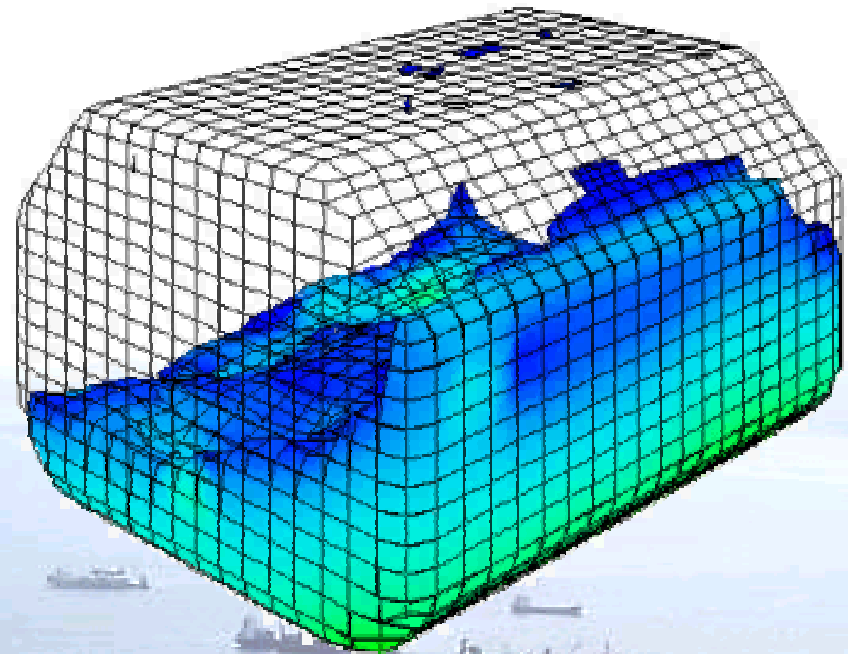


Kvaerner Moss - Spherical Tank Design



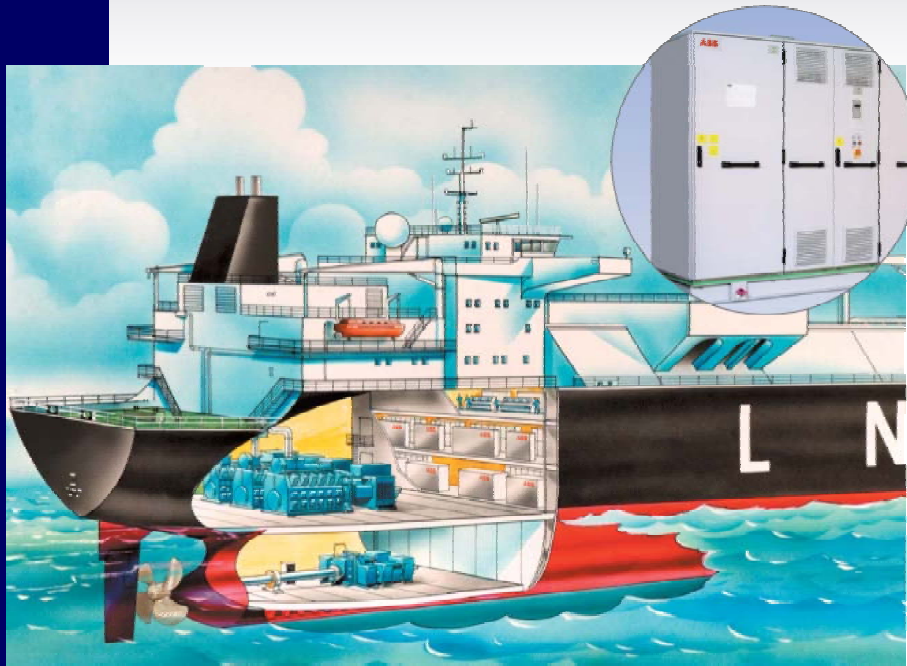
LNG Ships – Technical Issues

- **Size Increase** from 138,000 CbM to 250,000+ CbM
- **Re-gasification plants** on board
- **Ice strengthening** requirem'ts for various trade routes
- **Fatigue life** up to 50 years
- **Offshore Terminal** discharging which exacerbates loads due to sloshing



Dual Fuel Electric Propulsion

(Diesel and Electric)



- 185 LNG ships in service
 - Steam turbine
- 123 LNG ships on order
 - 77 –Steam turbine
 - 45 -Diesel
 - 25-dual fuel diesel electric
 - 20 –slow speed diesel direct drive



Propulsion For Next Generation LNG Carriers

- **Alternative Propulsion**

(Existing fleet is all steam turbine)

- Propulsion efficiency
- New technology developments
 - Dual fuel - Natural Gas & Fuel Oil
 - slow & medium speed diesels & gas turbines
 - shipboard re-liquefaction plants
- Class societies offering technical guidance for alternative propulsion. Example: ABS Guide for Design and Installation of Dual Fuel Engines.



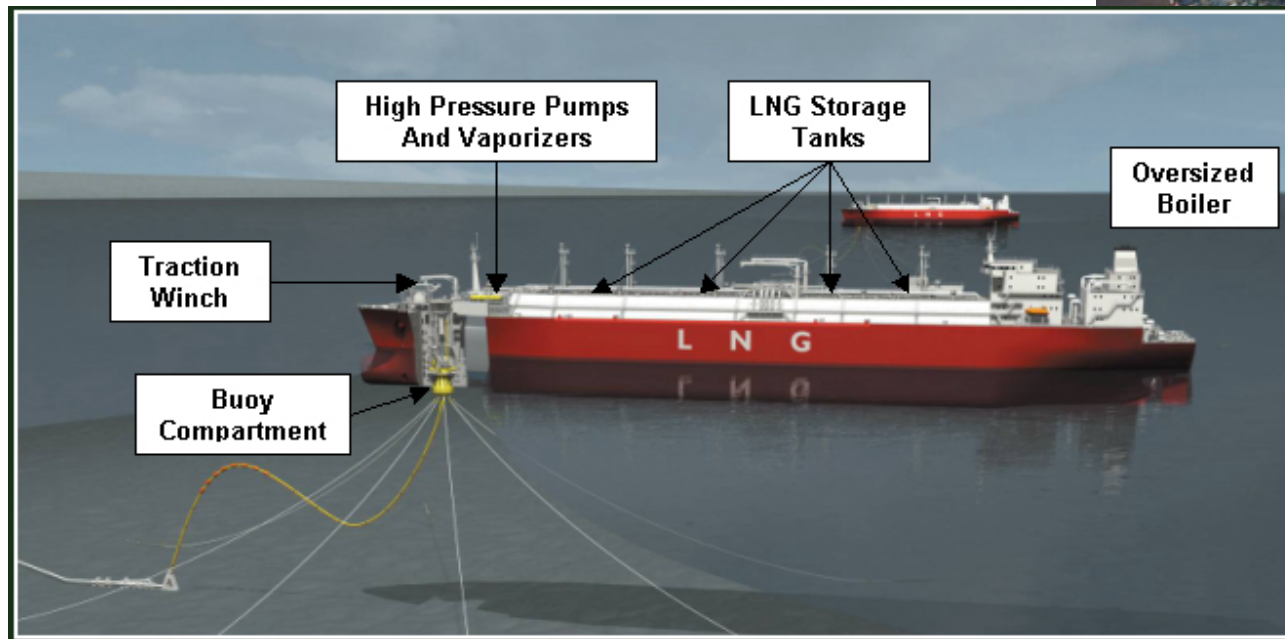
Special Concerns for LNG

- Gasification of LNG
- Loss of Containment
- Liquid Spill on Deck
- Gas Release
- Disposal of Boil-off
- Fire and Explosion
- Over-pressure or Under-pressure
- Ship to Terminal Transfer of LNG
- Partial Loading
- Layout Constraints



Energy Bridge Regas Vessel

- Specially built LNG carrier fitted with onboard re-gasification equipment to transfer gas through a buoy, which is connected to a pipeline end manifold (PLEM) on the seafloor

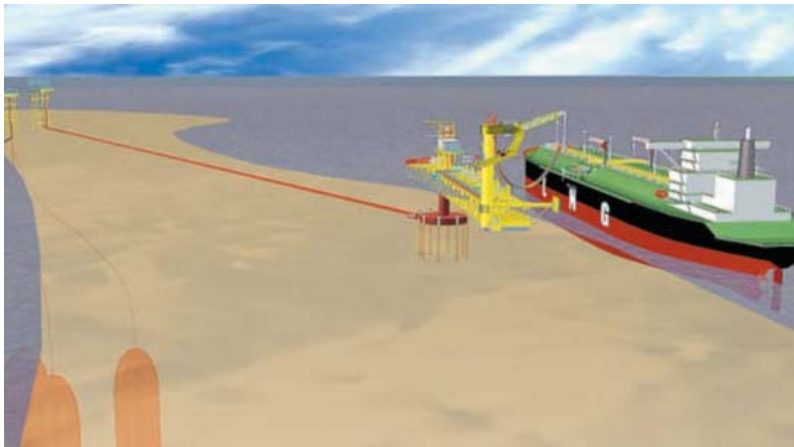


Offshore LNG Terminals/Concepts



Cabrillo Port Offshore California

- Floating ship shaped hull



CGI

- Floating or fixed
- “Bishop process”
- Storage of LNG in Salt Caverns



Offshore LNG Terminals/Concepts



Compass Port Gulf of Mexico

- Concrete Gravity Based (GBS)



Chevron-Texaco's Baja, California

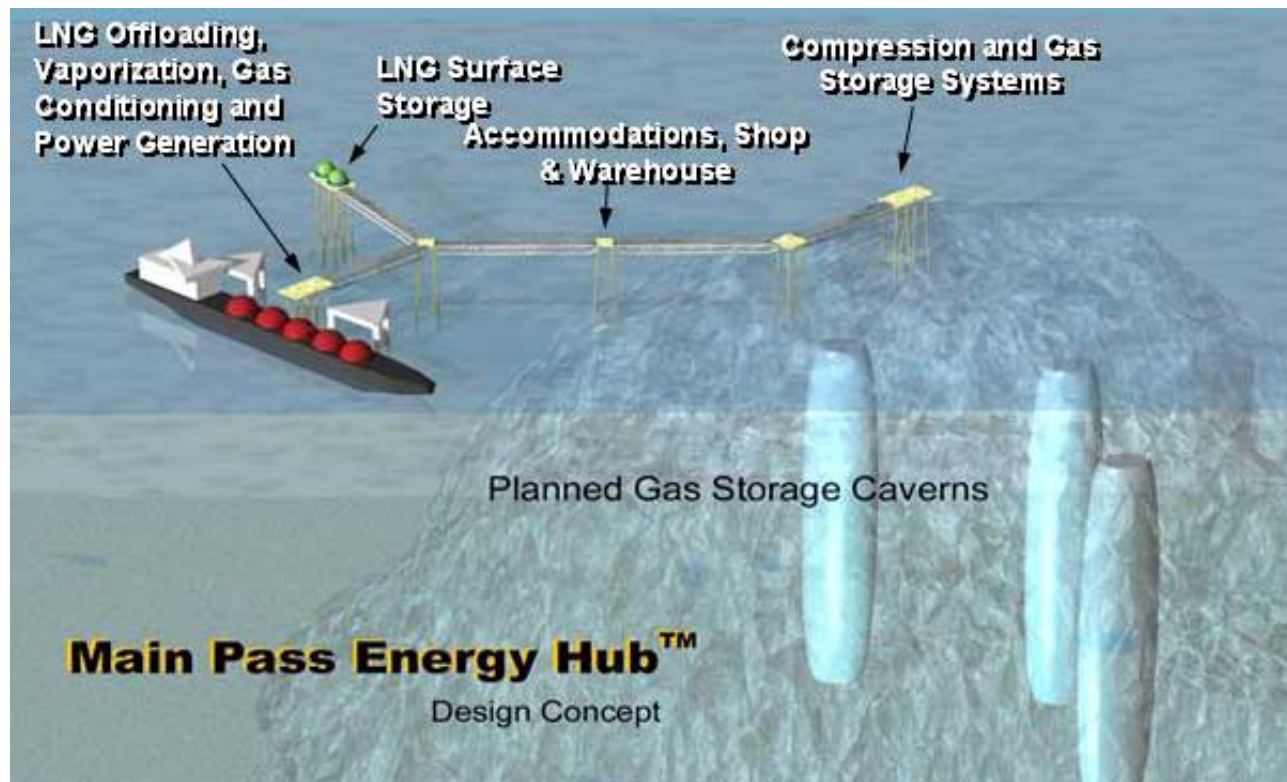
- Concrete Gravity Based (GBS)



Offshore LNG Terminals/Concepts

Main Pass Energy HubTM Gulf of Mexico

- Floating fixed platform



Closing Points

- First Transport of LNG by Sea was “Methane Pioneer” in 1959
- Today 185 LNG carriers transporting LNG from one region of the world to another...All of these vessels are “classed”
- Class societies serve as an independent third party verification agency

**.....Safety & Compliance With Rules
(Standards) are our Main Concern.....**



Closing Points

- LNG Fleet is Expanding Rapidly to Handle Increased Demand
 - Larger ships
 - Changing propulsion systems
 - Changes in operations
 - Expanding owner base
- Offshore LNG Terminals –various concepts, Technical considerations
- Class provides Rules and Technical Guidance for LNG carriers and terminals



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