





# Changing and Expanding Risks for LNG Carriers

- Is our perception updated? -

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# AGENDA



- Introduction
- Recent Growth of LNG Carriers
- LNG Carriers' Hazard
- Changing Context
- Conclusion

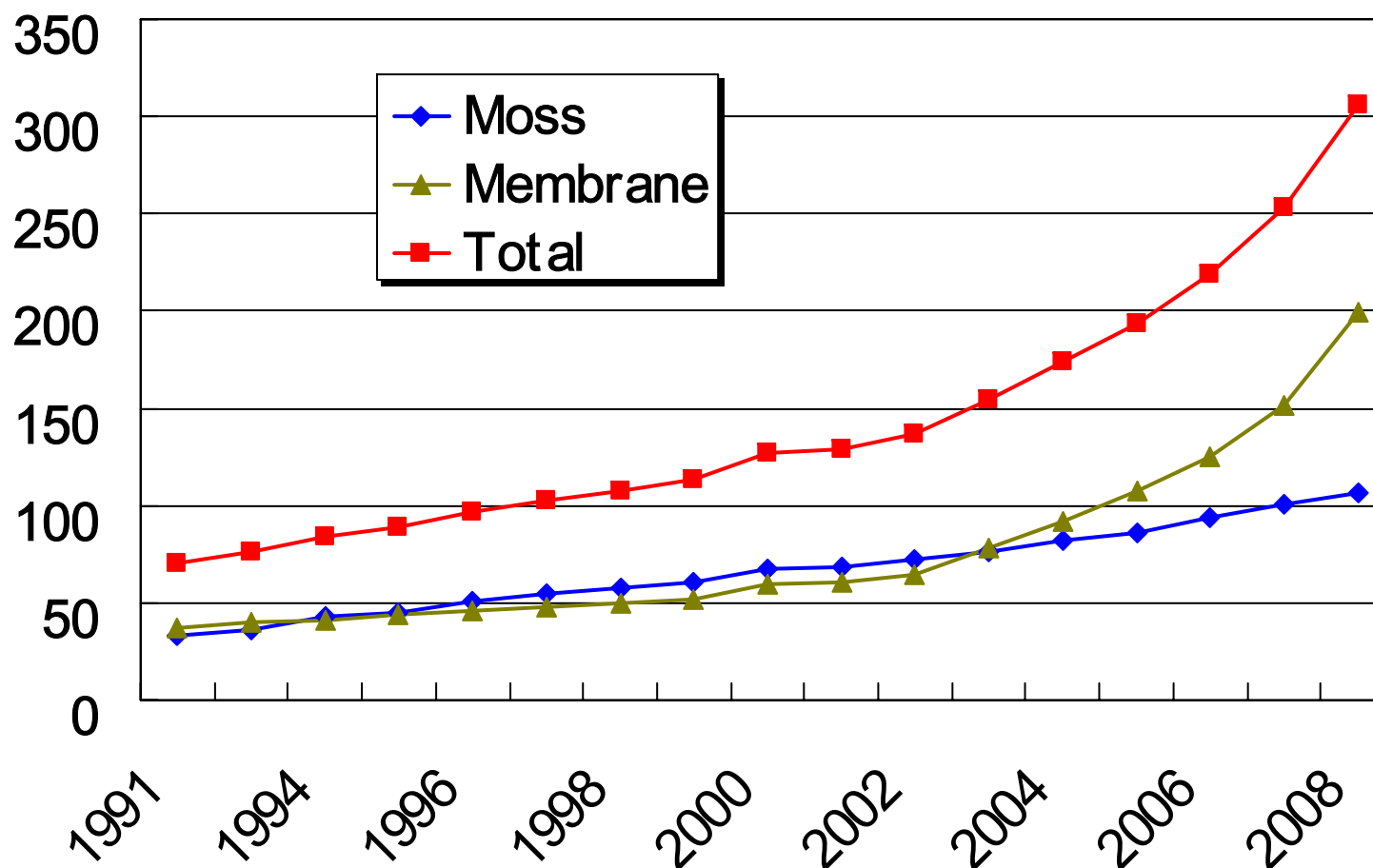


# Introduction

- What is LNG?
  - Liquefied Form of Natural Gas
  - Natural Gas cooled to **-161 C**
  - **625m<sup>3</sup>** of GNG = **1 m<sup>3</sup>**
- LNG Carrier
  - Unique cargo containment technology
  - Moss Spherical Type and Membrane Types
  - High Value

# LNGC development

## Number of LNGC in operation (Incl. Orderbook)

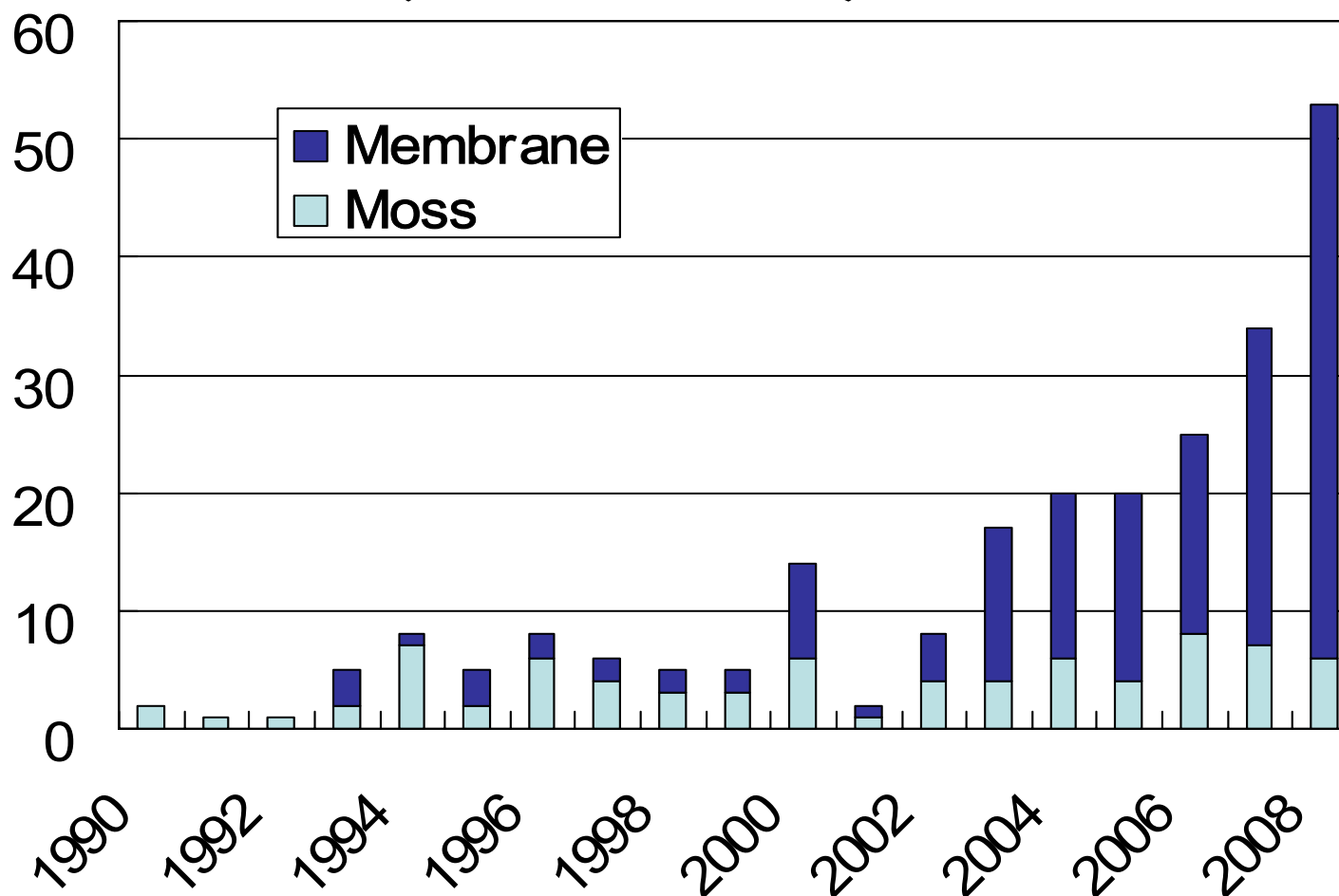




# LNGC development

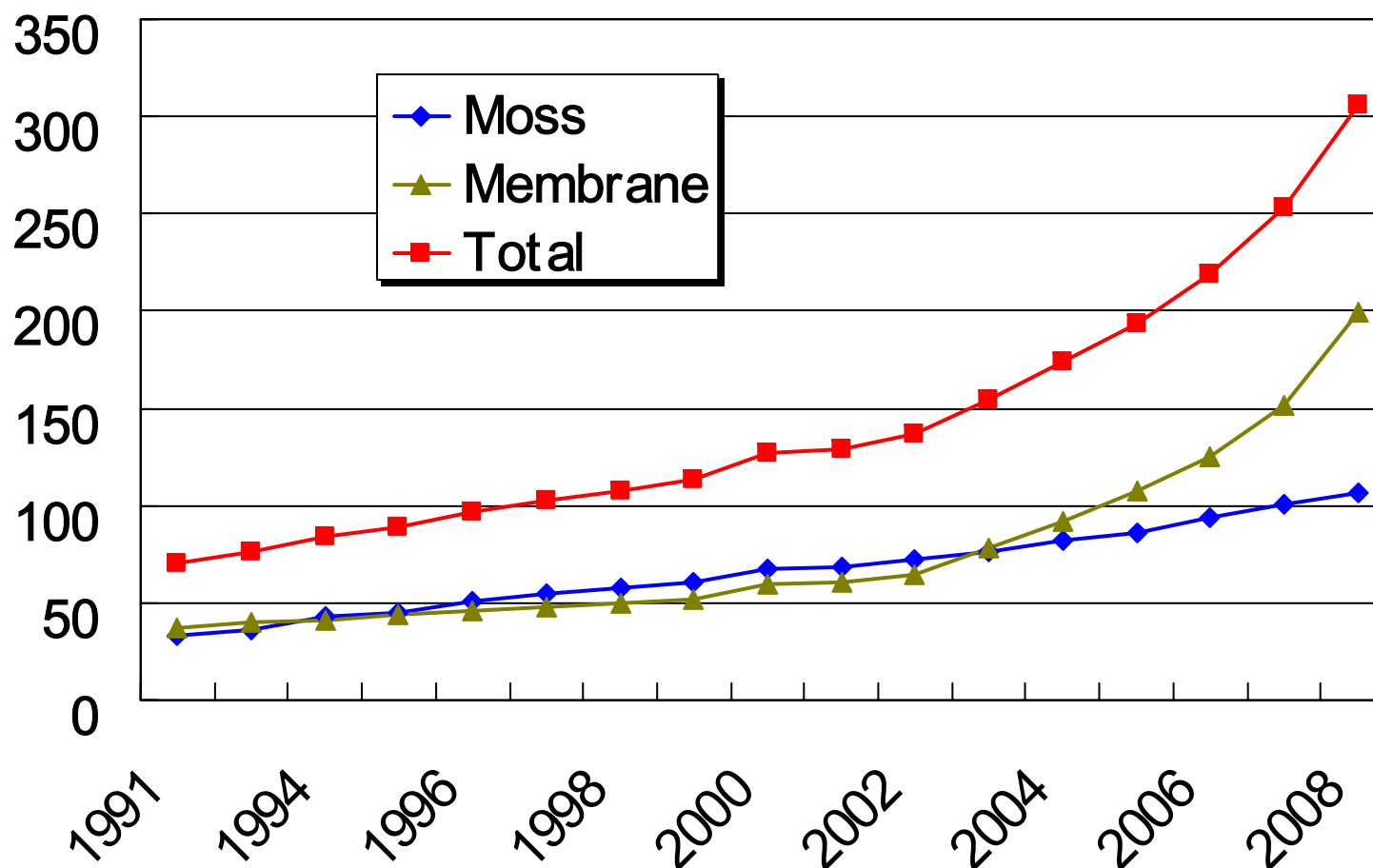
## Number of New Buildings

(Incl. Orderbook)



# LNGC development

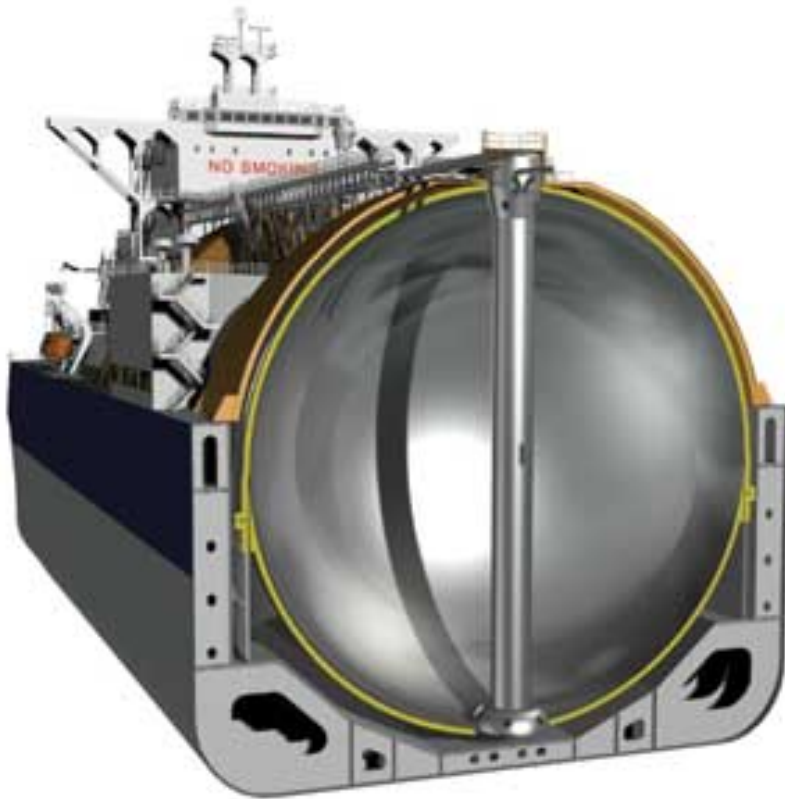
## Number of LNGC in operation (Incl. Orderbook)



# Review of Tank Structure



Moss Spherical



Membrane



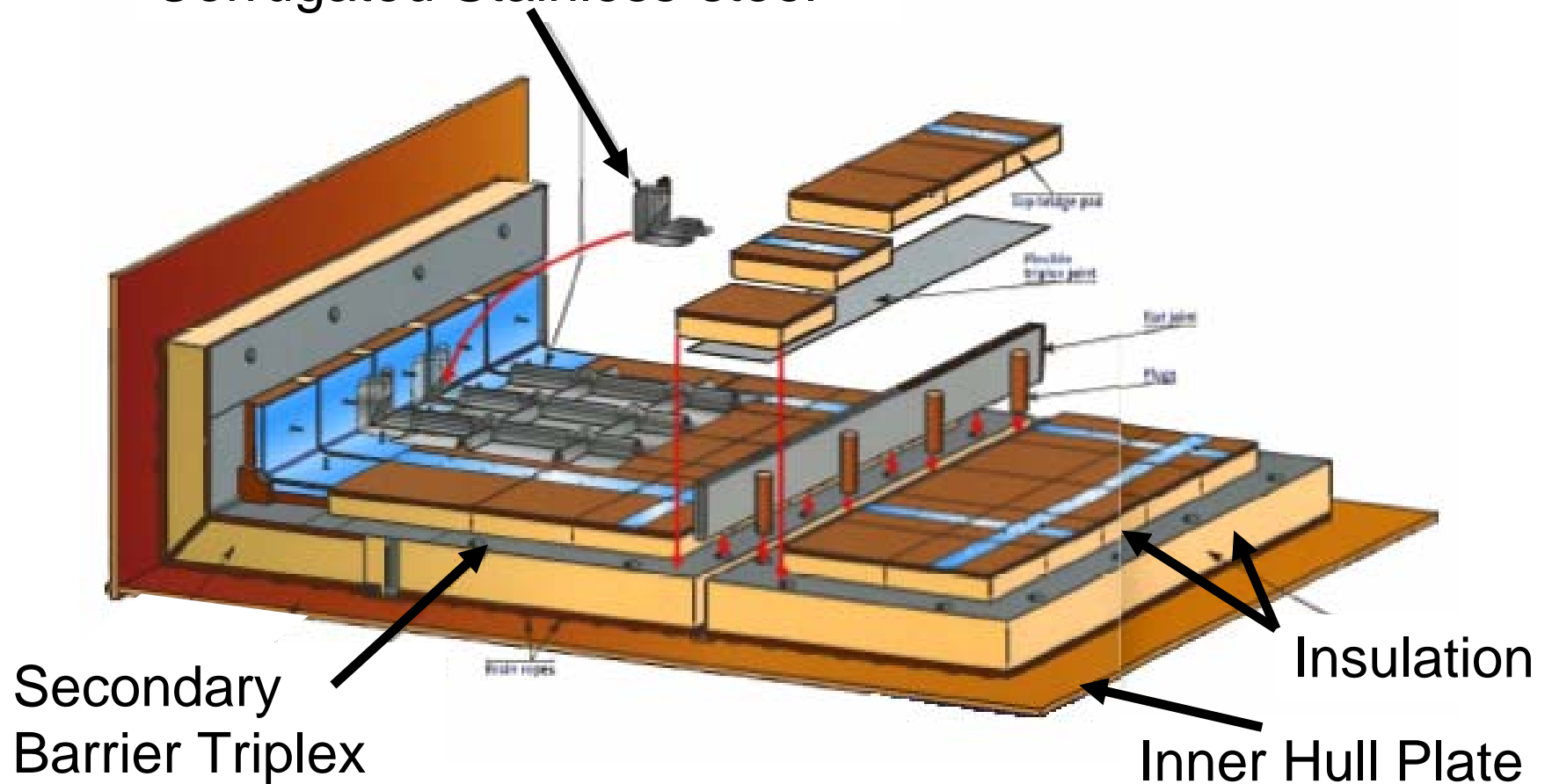


# Membrane Tank Structure

## GTT Mark III

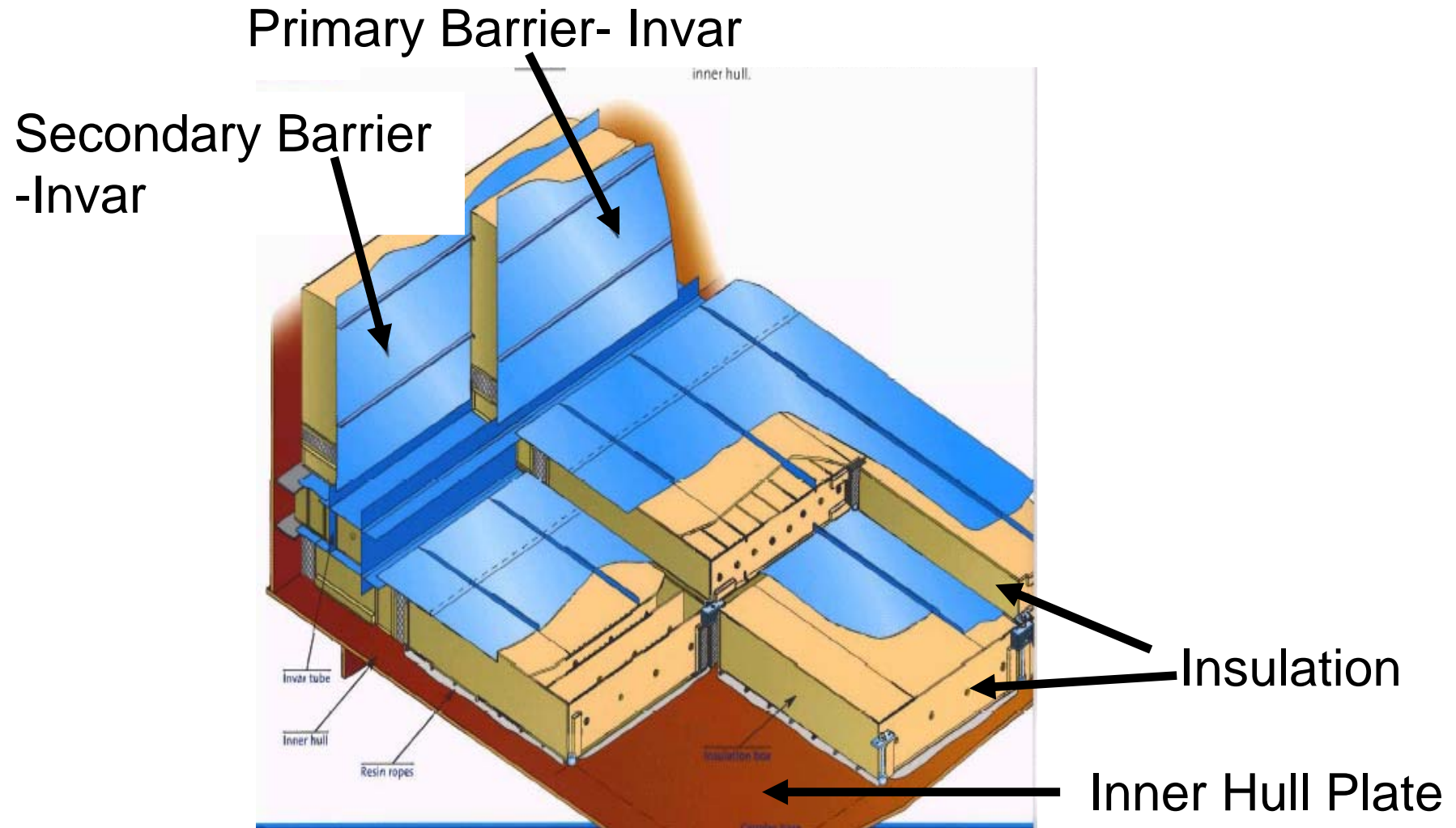


Primary Barrier:  
Corrugated Stainless-steel



# Membrane Tank Structure

## GTT No. 96



# LNGC Hazards and Risk Assessment



## LNG Vessels can be involved in accidents :

- Grounding
- Striking a fixed object
- Collision
- Unloading/Loading
  - Sudden pull-away and damage of loading / discharging arms
  - Cracking of ship hull due to super cold shock (-161C)
- Cargo containment (cargo sloshing) and cargo machinery
- Other usual hull/machinery accidents
- Terrorism

# LNGC Hazards and Risk Assessment



## “GROUNDING”

### **Moss Type**

1980, grounding off Tobata, Japan

→No Tank Damage

→ 2,300 tons steel work, 4 months repairs

### **Membrane Type**

1979, grounding off Gibraltar

→Tank Damage

→2,500 Tons steel work, 18months repairs

2004, grounding off Korea

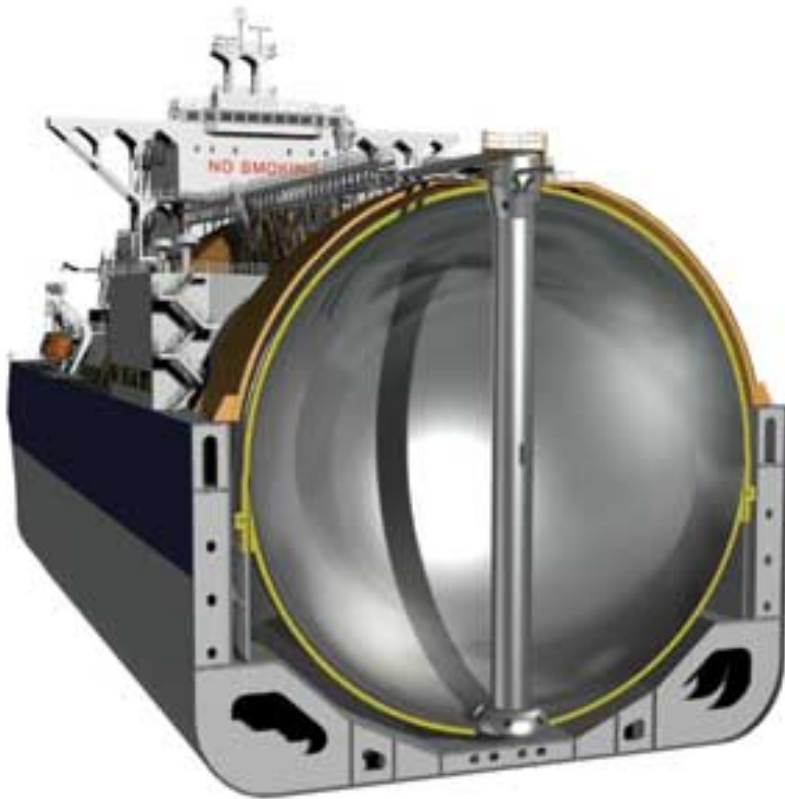
→Tank Damage

→Few hundred steel work, 8 months repairs

# Review of Tank Structure



Moss Spherical



Membrane



# LNGC Hazards and Risk Assessment



## “CARGO SLOSHING”

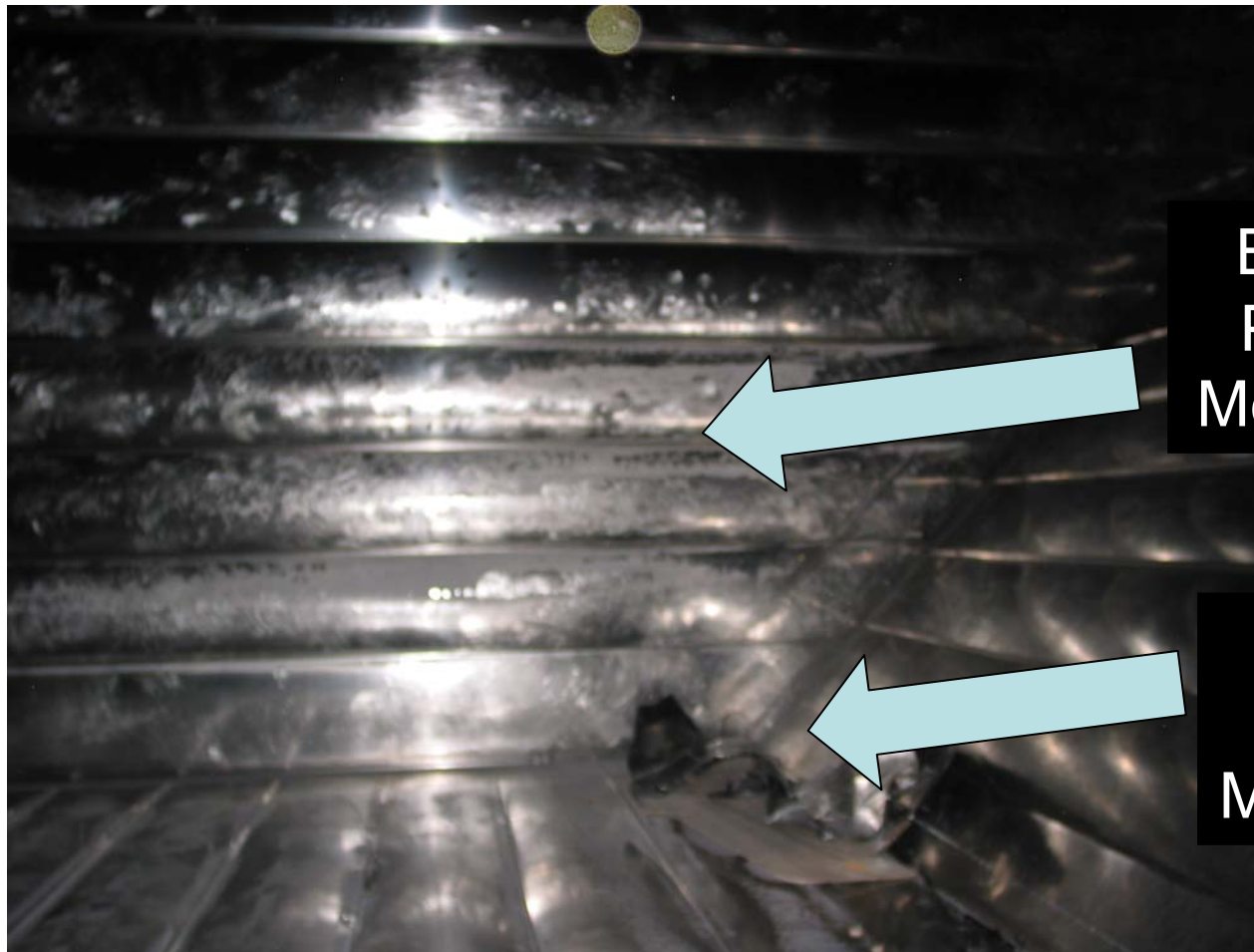
- What is cargo sloshing?



# LNGC Hazards and Risk Assessment



## “Example of CARGO SLOSHING”



Buckled  
Primary  
Membrane

Broken  
Primary  
Membrane

# LNGC Hazards and Risk Assessment



## “CARGO SLOSHING”

- What is cargo sloshing?
- Loading restriction and certain change in design seemed to have provided a solution

However.....

- 2006, cargo sloshing damage found, in a LNGC fully complied with loading restriction.
- Following the incident, loading restriction recommendation revised.

► **Still an Ongoing Problem!**



# LNGC Risks Looking Future

## New Technology



- LNGC have been long dominated by Steam Turbine.
- Totally new propulsion systems being introduced
  - Dual Fuel Diesel + Electric Motor
  - Diesel + Reliquefaction plant
- Steam Turbine is regarded as “proven technology”
- ▶ Deviation from “proven-tech” = Adds Unknown Factor

# LNGC Risks Looking Future

## Builder Quality Issue



- Number of shipyards joining LNGC building.
  - Very large demand seems to put pressure on the adequacy of experienced shipyard workers.
- 
- ▶ Recent incidents, not only under construction but incidents materialized after delivery, strengthen above concern.

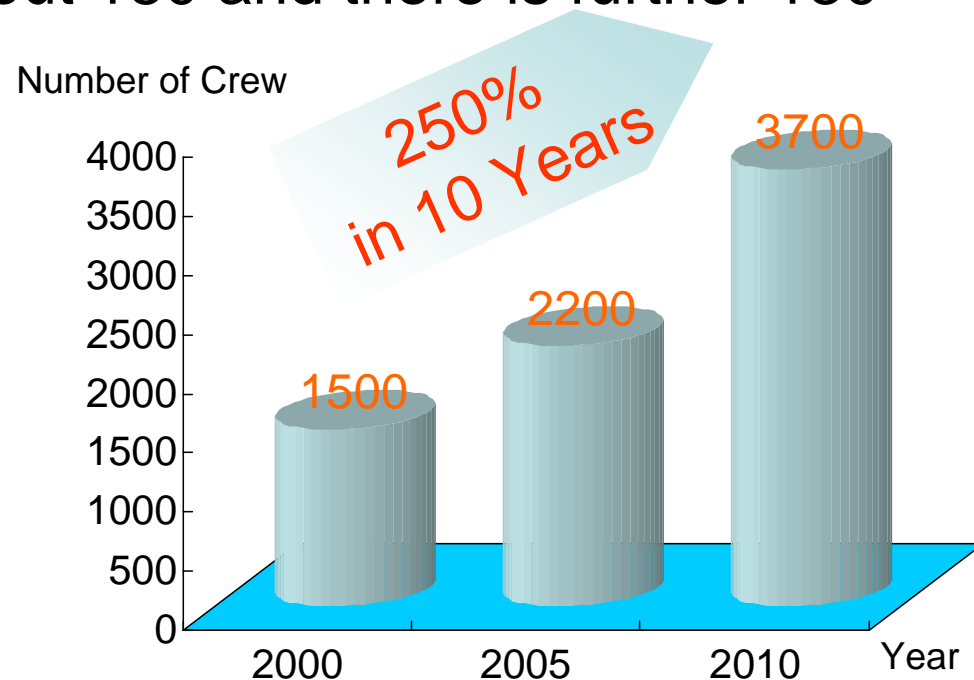
# LNGC Risks Looking Future

## Demands for Experienced Crew



- At year 2000, the number of LNGC were 130, at year 2005, it increased to about 180 and there is further 130 on order

LNGC require high quality crew with special expertise. Assuming 6 senior officers with 6 back up:



In addition, many new buildings imply most experienced staff get diverted to ship construction superintendents

# LNGC Risks Looking Future

## Change of Trading Pattern



- Spot Trade come into existence
  - emergence of non “take or pay” supply
  - softening of resale restriction
- More Trampler Type Transportation
  - Participation of New Operators
  - Voyage to un-familiarized ports

## Concluding Remarks

- Each type of LNG containment system poses quite different risk implication to underwriters.
- Changing context, LNG trade pattern, crewing situation and etc is changing risk implication as well.
- “Risk Assessment and Loss Prevention- a Common Goal”

**Is our perception of LNGC  
adequately updated?**



# QUESTIONS ?





**THANK YOU!**





## References

De Regt (2004), "Safety & Risk Aspects of LNG"

Pitblado et al (2004), "Consequences of LNG Marine Incidents"

Itoyama (2005), "LNG sen ga wakaruhon"

NYK Line Operation Research Committee (2006) "LNG Ships Operations"

Various articles from Trade Winds

Energy Information Administration

## Images from:

### **Gaztransport and Technigaz Naval engineering brochures**

Mark III System

No. 96 System

CS 1 System

### **Moss Systems engineering brochures**

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