Arctic Shipping & Class

St. Regis Hotel, Washington, D.C.
05 June 2008

U.S. Maritime Administration
Arctic Shipping Conference

Thomas H. Gilmour
President, Chief Operating Office
ABS Americas

The Lure

- Transit from London to Tokyo shortened from 15,000 miles via the Panama Canal to 8,500 miles using the Northwest Passage
- Receding polar ice may allow routine passage of the Northwest Passage as early as 2020
- 25% – 30% of the worlds unexploitated oil and gas reserves are in the Arctic

“The Era of Easy Energy is Over”

First Ice Breaking Tanker

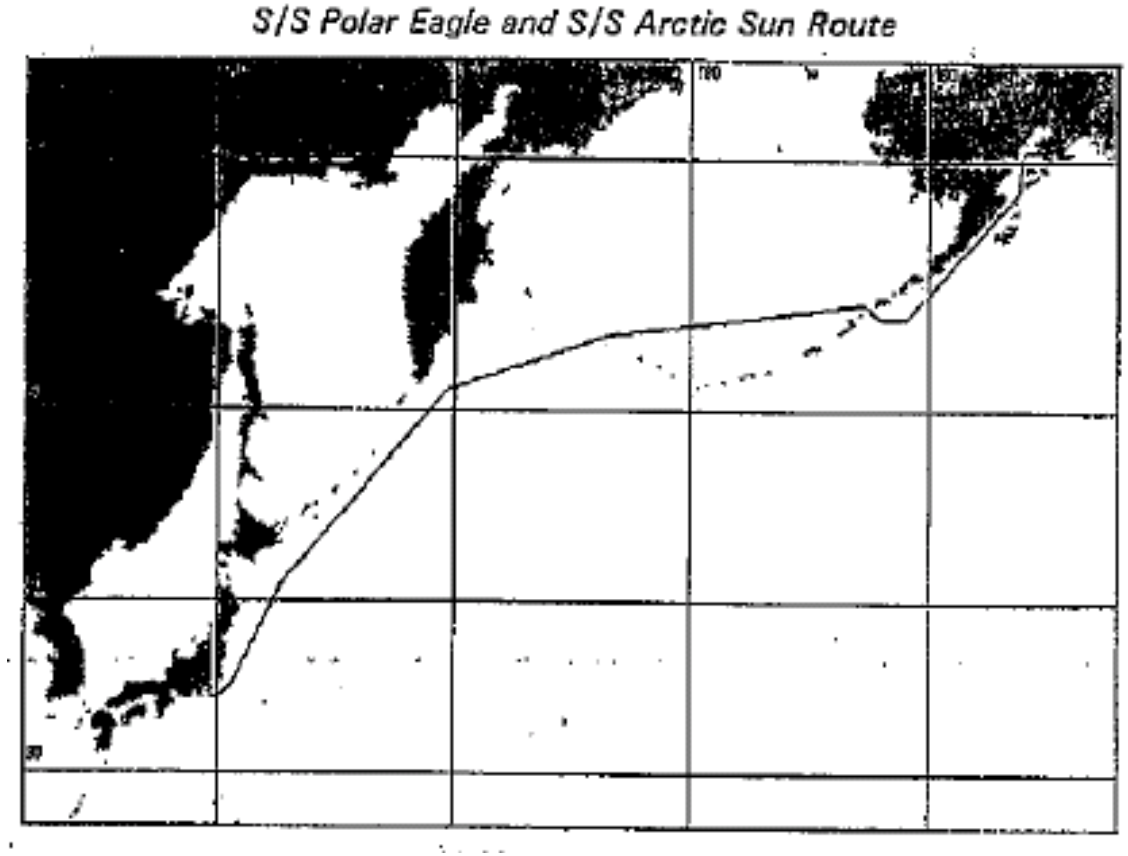
ABS was part of the team to produce the first ever commercial ship to navigate the NW passage – the ice breaking tanker, Manhattan

87,500 m3 SPB LNG Carrier

“POLAR SPIRIT” & “ARCTIC SPIRIT”

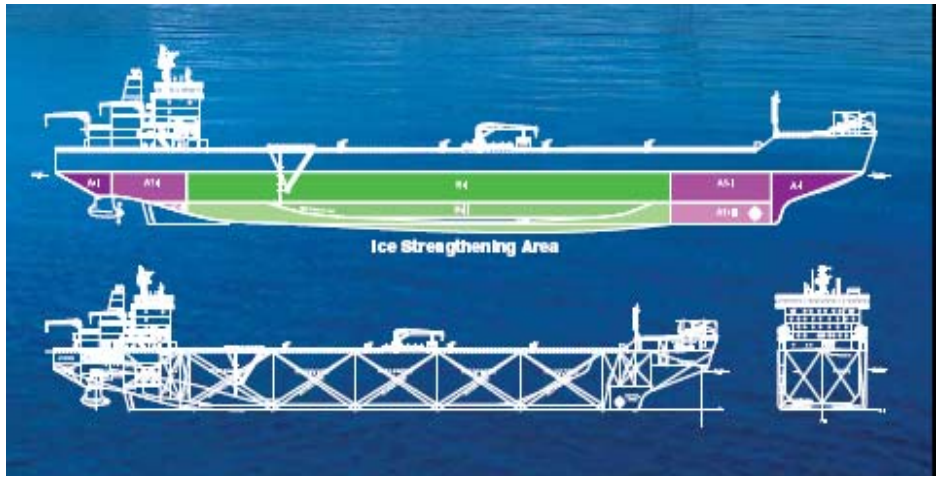
ABS +A1 Liquefied Natural Gas Carrier,
Ice Class C, (E), +AMS, +ACCU, +APS

Trade Route



Between Kenai (Alaska) - Tokyo

Arctic Shuttle Tanker



VASILY DINKOV

- Largest commercial ship designed and built for year round Arctic service
- Double acting design allows ice breaking in both ahead and astern operation

Challenges for Arctic Transportation

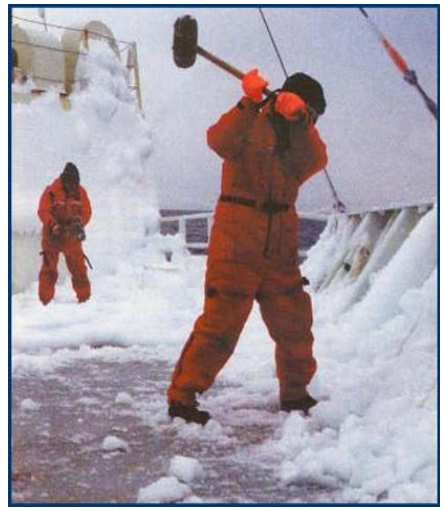
Safety

- Loads on the hull and appendices
- First year and multiyear ice

- Design of equipment for low temperatures
  - Freezing conditions
  - Icing and ice blockage
- Lack of experience with larger vessels
- Remoteness and lack of infrastructure

Challenges for Arctic Transportation

- Impact on the crew
  - Cold temperatures
  - Lack of light and visibility
- Safety equipment fit for the conditions
- Lack of operational experience
- Lack of trained crew



Challenges for Arctic Transportation

- Unique environment
- Oil spill recovery difficult
  - Ice
  - Remote
  - Lack of infrastructure
- Slow ecological recovery
  - Low temperatures and short summer

IACS Polar Class Descriptions

PC1	Year-round operation in all polar waters
PC2	Year-round operation in moderate multi-year ice conditions
PC3	Year-round operation in second-year ice with old ice inclusions
PC4	Year-round operation in thick first-year ice with old ice inclusions
PC5	Year-round operation in medium first-year ice with old ice inclusions
PC6	Summer-fall operation in medium first-year ice with old ice inclusions
PC7	Summer-fall operation in thin first-year ice with old ice inclusions

Ice Strengthening of Hull and Machinery

Selection of Ice Class – Requirements for hull structure and machinery

Harsh Environment

- Green water on deck
- Slamming
- Fatigue
- Sloshing
- Low visibility

Cold Climate Operations - Icing

Access to control and safety equipment

Arctic Shipping Regulatory Framework - International

IMO "Guidelines for Ships Operating in Arctic Ice-Covered Waters" (2002)

- IMO Guidelines are recommendatory for vessels operating in the Arctic ice-covered waters
- Construction, equipment, operation
- Hull and machinery requirements refer to IACS Polar Class UR
- Equipment for low temperature - fire safety, life-saving appliances, navigational equipment
- Operational control, operating manual, training manual, crewing and emergency equipment

Ice Class Requirements

- Merchant vessels intended to operate in ice covered waters are designed in accordance with Ice Class requirements
- First ice strengthening requirements in 1930's by Swedish Board of Navigation, later called Finnish-Swedish Ice Class Rules (FSICR)
- Major classification societies have adopted FSICR and developed own Ice Class requirements
- In 1972 Canadian Coast Guard published Canadian Arctic Shipping Pollution Prevention Regulation (CASPPR)

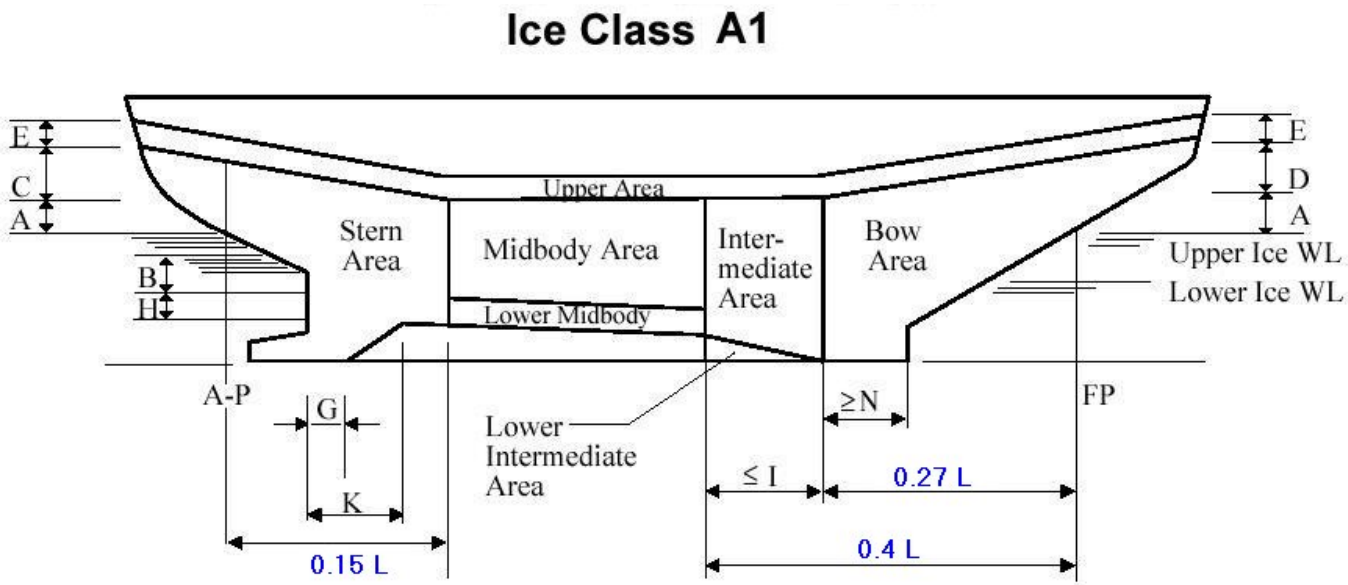
What is Ice Class?

Ice Class is part of the vessel's Classification Notation

- Technical drawings have been reviewed and approved for compliance with ABS' Ice Class Rules
- Surveys are carried out during construction to check that the vessel is built in accordance with the approved plans
- Periodic surveys are carried out to verify that the vessel remains in compliance with class requirements

Ice Class Requirements

Ice Class requirements cover hull and propulsion machinery



Ice Class Rule Development

Technical Challenges

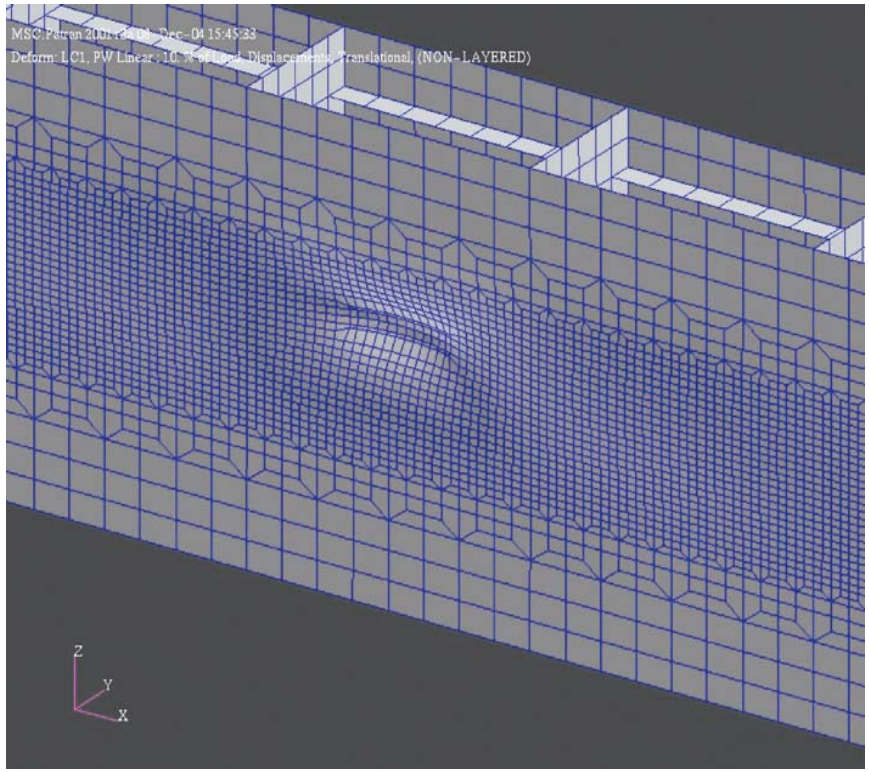
- Existing rules based on experience from smaller vessels
- New ship types require further considerations – for example LNG
- New design concepts not covered by traditional rules
- Not all aspects of design for cold climates are covered by Class Rules

IACS Polar Class UR Development

- UR I1 – Polar class descriptions and applications
- UR I2 – Structural requirements for polar class ships
- UR I3 – Machinery requirements for polar class ships

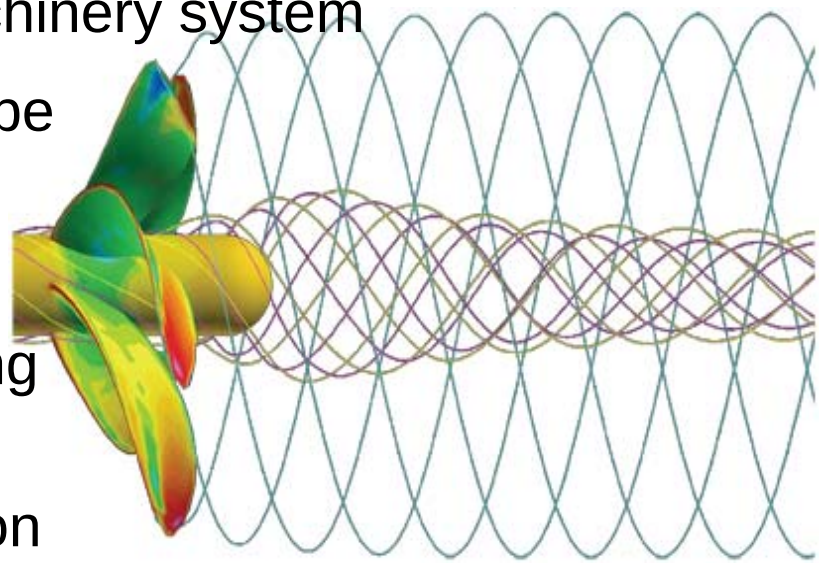
Structural Requirements for Polar Class Ships

- Design ice loads
- Strength requirements for shell plating, frames, bulkheads
- Material requirements and abrasion/corrosion allowance



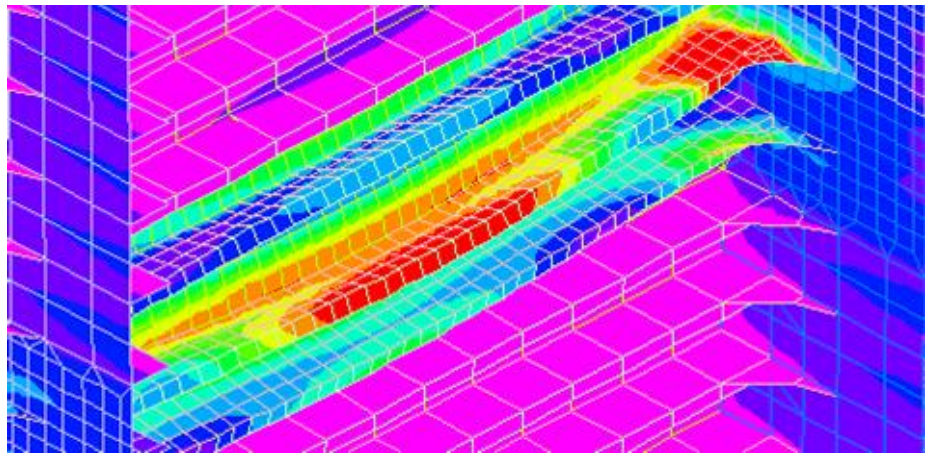
Machinery Requirements for Polar Class Ships

- Ice loads and failure criteria for the propulsion machinery
- Design guidance for the machinery system
- Detailed scantling design to be done either using advanced analysis methods (FEM for propeller blade strength) or accepted industry engineering practice
- Minimum power for propulsion not included



Beyond Ice Class Requirements

- Procedures for ice-strengthening design using the latest nonlinear FEM methodology
- Procedures to assess powering and propeller strength for ice navigation



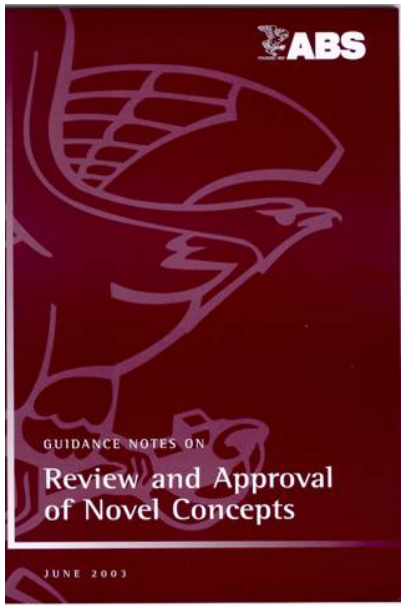
Beyond Ice Class Requirements

ABS Guide for Vessels Operating in Cold Climates

- Hull construction and equipment
  - Material selection
  - Tank arrangement and heating
  - De-icing
- Systems and machinery
  - Reliability and redundancy
  - Deck machinery
  - Piping
- Safety systems
  - Life saving appliances
  - Navigational systems
- Ergonomic considerations
  - Enclosed work spaces
  - Protective gear
  - Insulation of accommodation spaces
- Training and manning
- Environmental protection

Beyond Ice Class Requirements

ABS Guidance Notes on Review and Approval of Novel Concepts

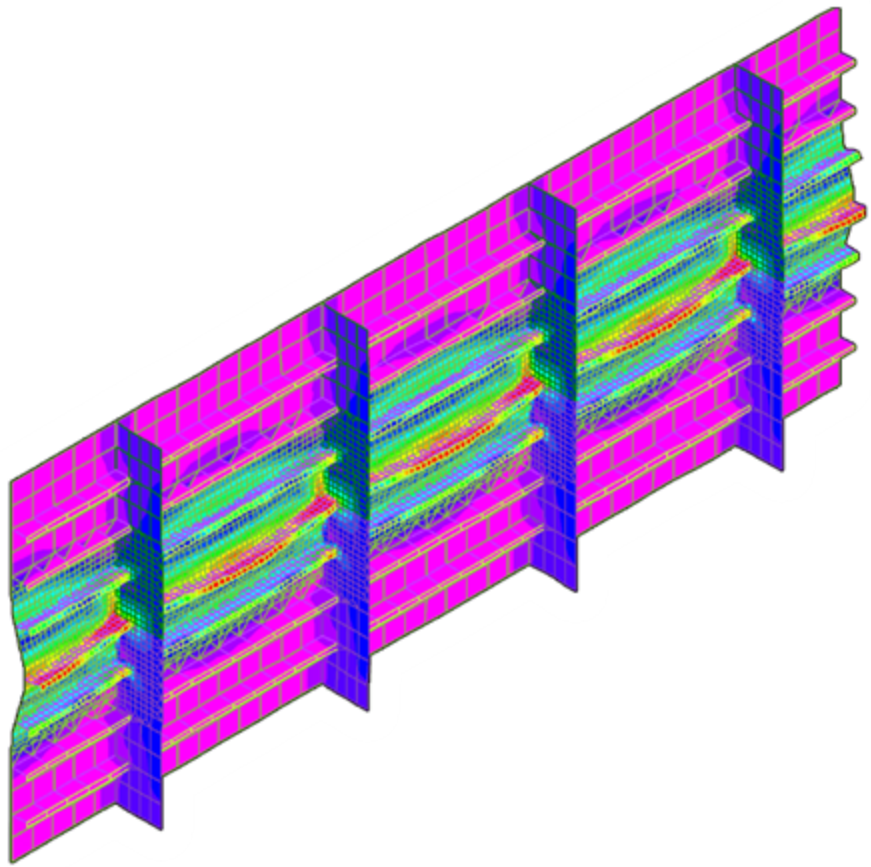


- Relies on risk assessment techniques to anticipate hazards
- Hazard identification leading to prevention and mitigation of undesired events as the project evolves
- Acceptable level of safety, in line with current offshore and marine practice

Arctic Operations - Current Activities

- *Research into structural integrity*

- In the absence of experience, first-principles approaches will be required for assessing the hulls of LNG carrier designs
- Example of the finite element analysis of ice-strengthened tanker side structure including the effect of response beyond yield

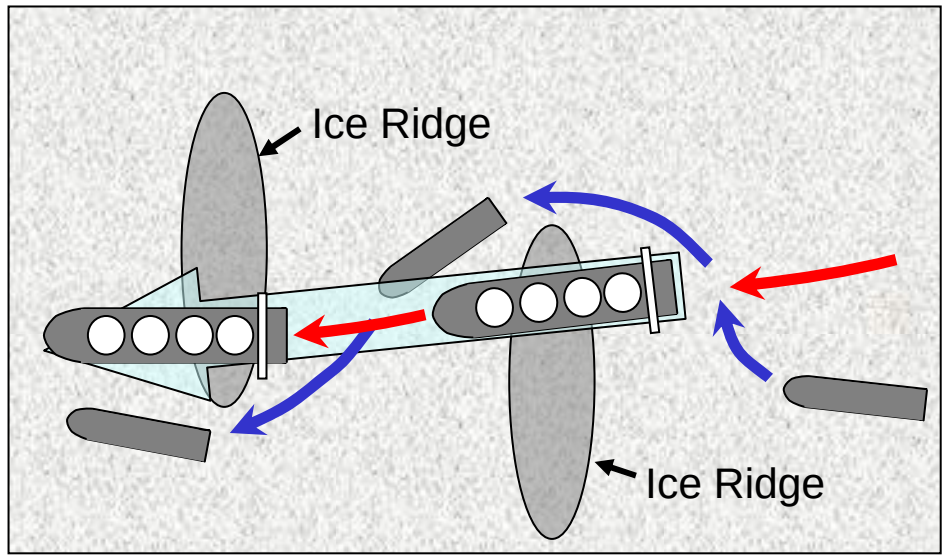


Arctic Operations - Current Activities

- *Research into structural integrity*

Establishing Design Scenarios

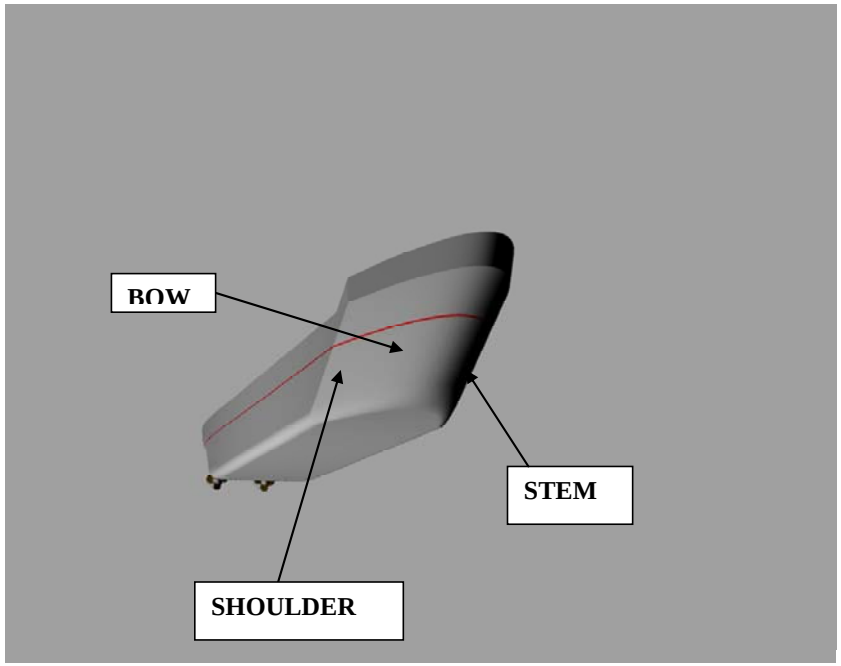
- Important to understand operational scenarios for large LNGC carriers
  - Many ice-covered routes are draft limited
  - Escorted, convoys
  - Maneuverability

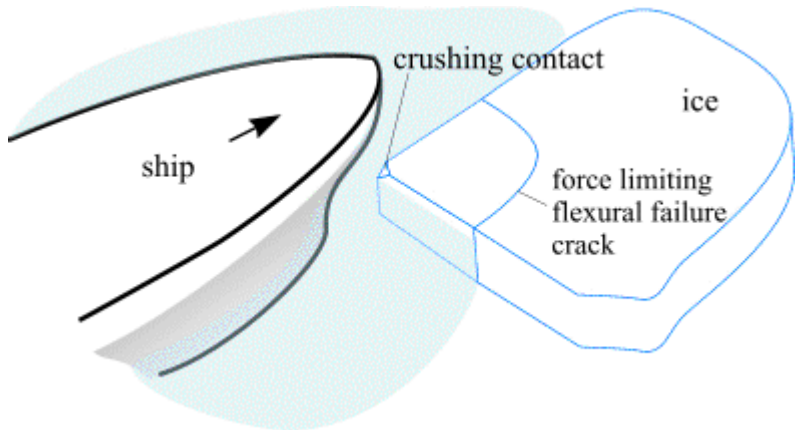


Arctic Operations - Current Activities

- *Research into structural integrity*

- Establishing Design Scenarios
  - Loads will depend on region of hull, interaction mechanism, and speed





Future Outlook

Growing oil & gas exploration, tourism and research activities will stress existing arctic coastal infrastructure:

- Ice management
- Salvage
- Spill response
- Rescue
- Waste reception
- Air emissions

Environmental issues will remain center stage.

www.eagle.org