Oil & Gas Exploration, Production and Transportation in the Arctic

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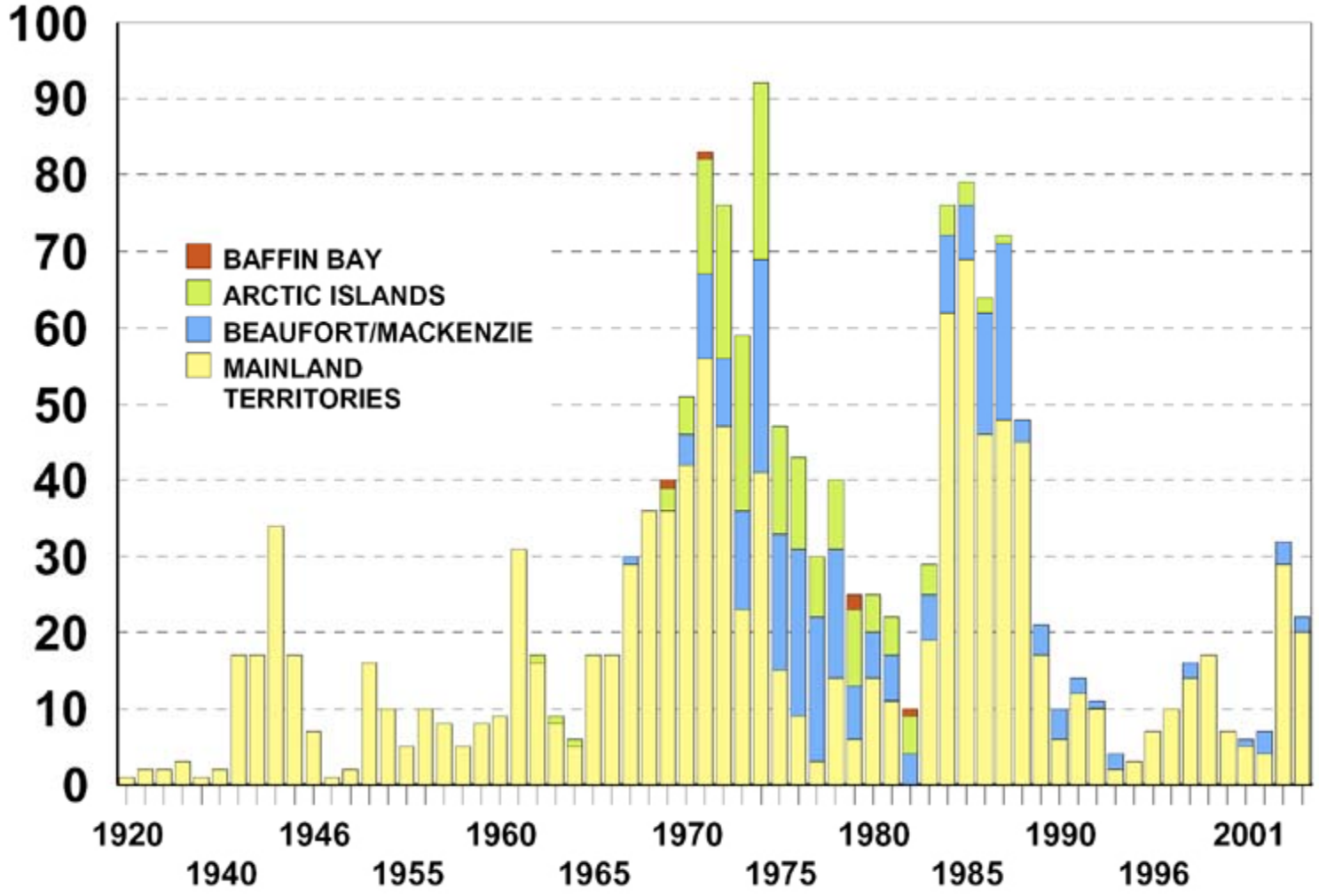
Background

- Arctic activity for oil & gas exploration, production and development is expanding after a hiatus of ~20 years.
- The first “ice age” for the offshore oil & gas industry was from the 1960s to 1980s
- We are now entering the second oil and gas “ice age”.
- This current expansion is primarily market driven by the demand for new hydrocarbon resources, rather than driven by an current or future changes in the climate of the Arctic region.

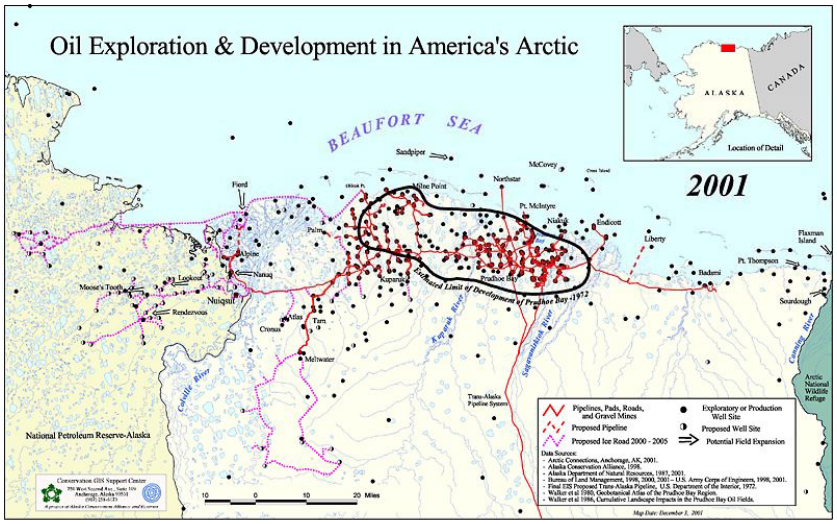
The first Arctic Oil and Gas "Ice Age"

- North Slope Alaska
  - Manhattan N.W Passage voyages
  - Prudhoe Bay Oil Developments
  - TAPS – trans-Alaska pipeline system
- Canadian Beaufort Sea
  - Dome Petroleum and Gulf Canada exploration
- Canadian Arctic Islands
  - Oil and gas exploration
  - Arctic Pilot Project – LNG to eastern seaboard
  - Small scale pilot oil export – Bent Horn

Wells drilled north of 60 - Canada



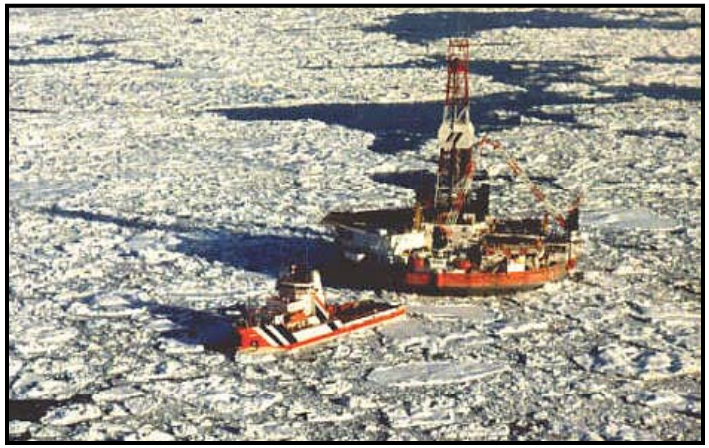
North Slope Oil



Beaufort Sea Drilling Units

Drillships – McKinley Bay

Molikpaq Drilling Caisson



Kulluk Circular Drillship

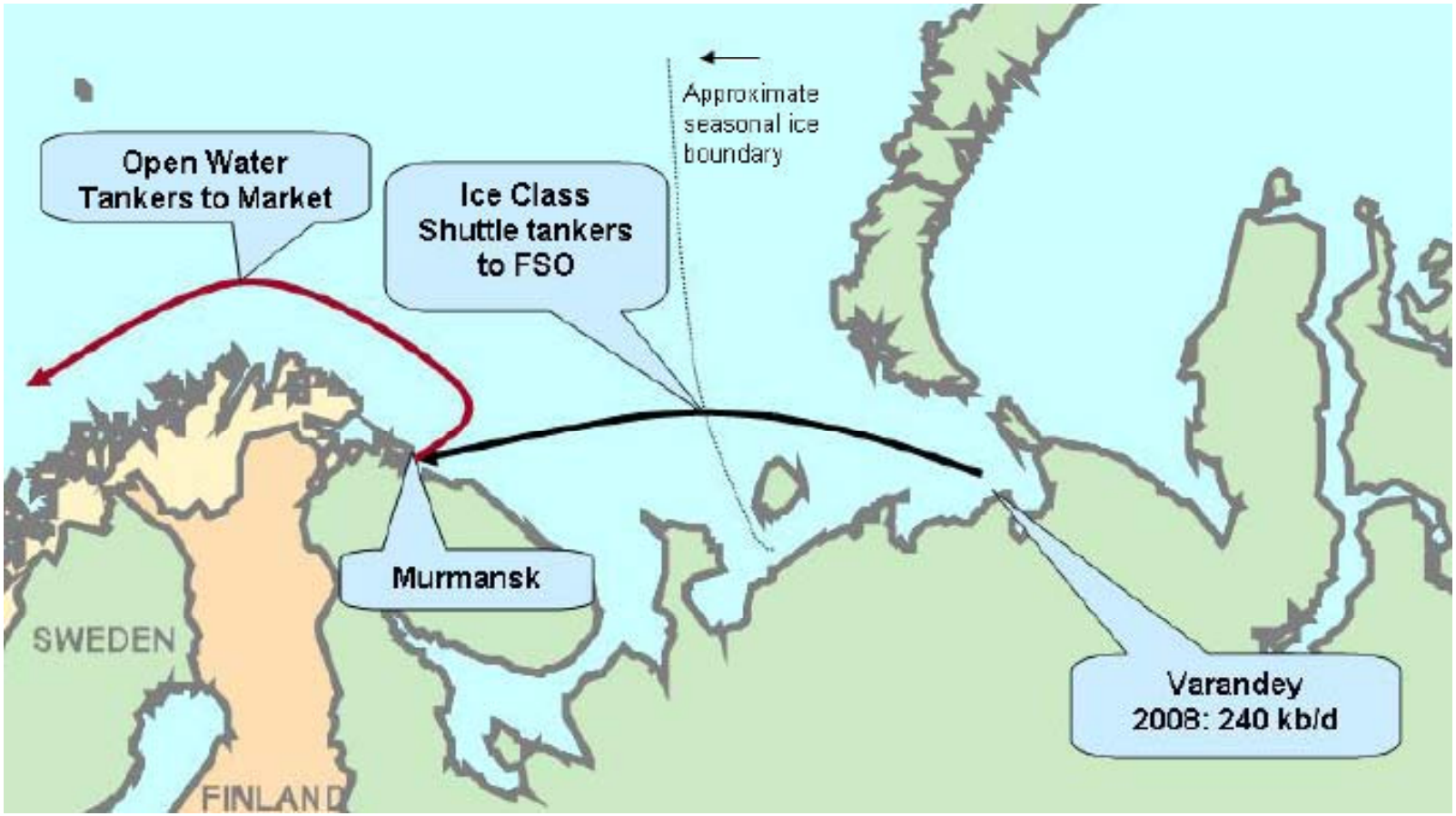
SSDC Drilling Unit

Beaufort Sea Support Icebreakers

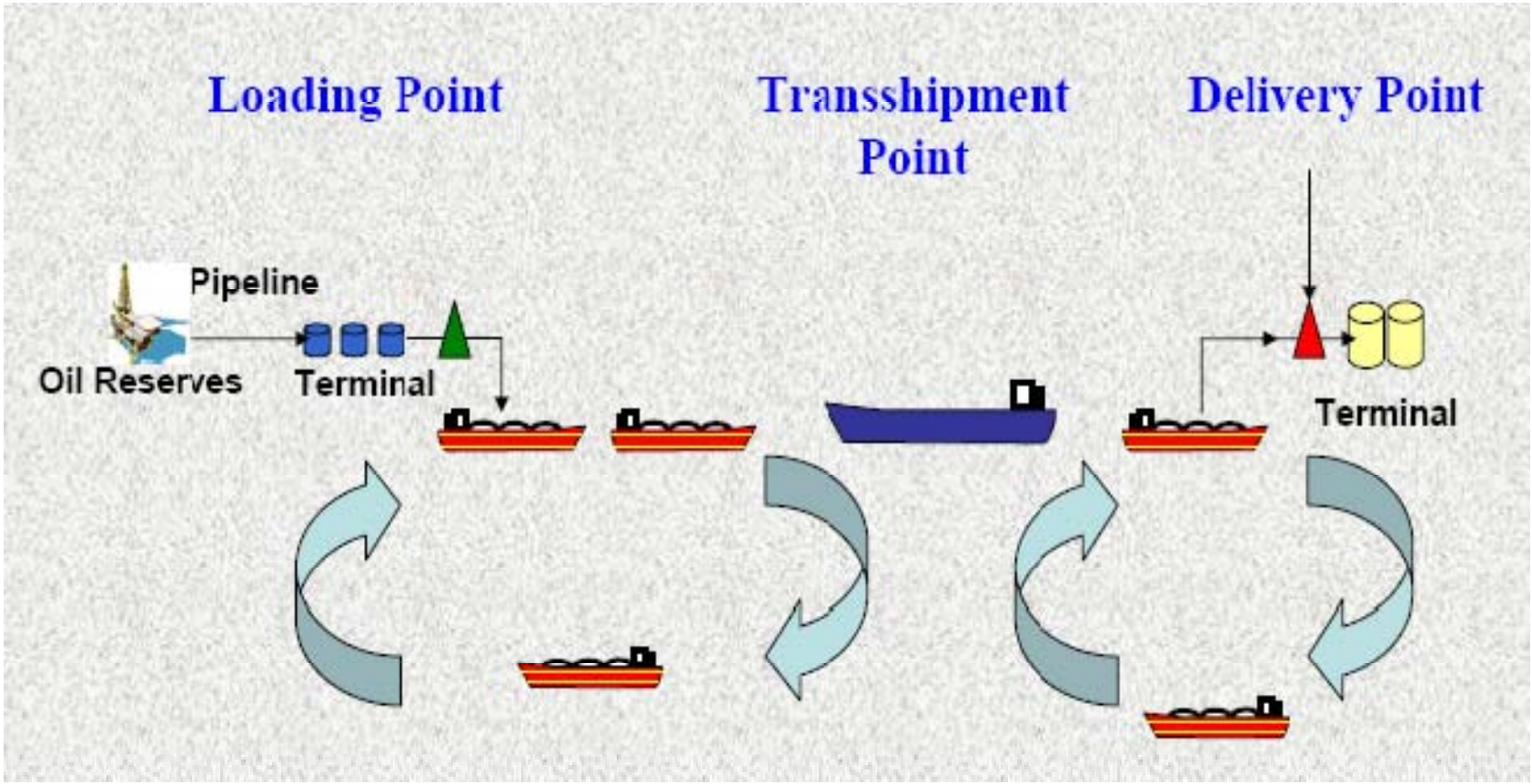
Current & Future Arctic Oil & Gas Developments

- US Beaufort and Chukchi Seas
- Canadian Beaufort Sea
- Canadian Arctic Islands
- Norwegian and Russian Barents Seas
- Russian Timan-Pechora and Kara Seas

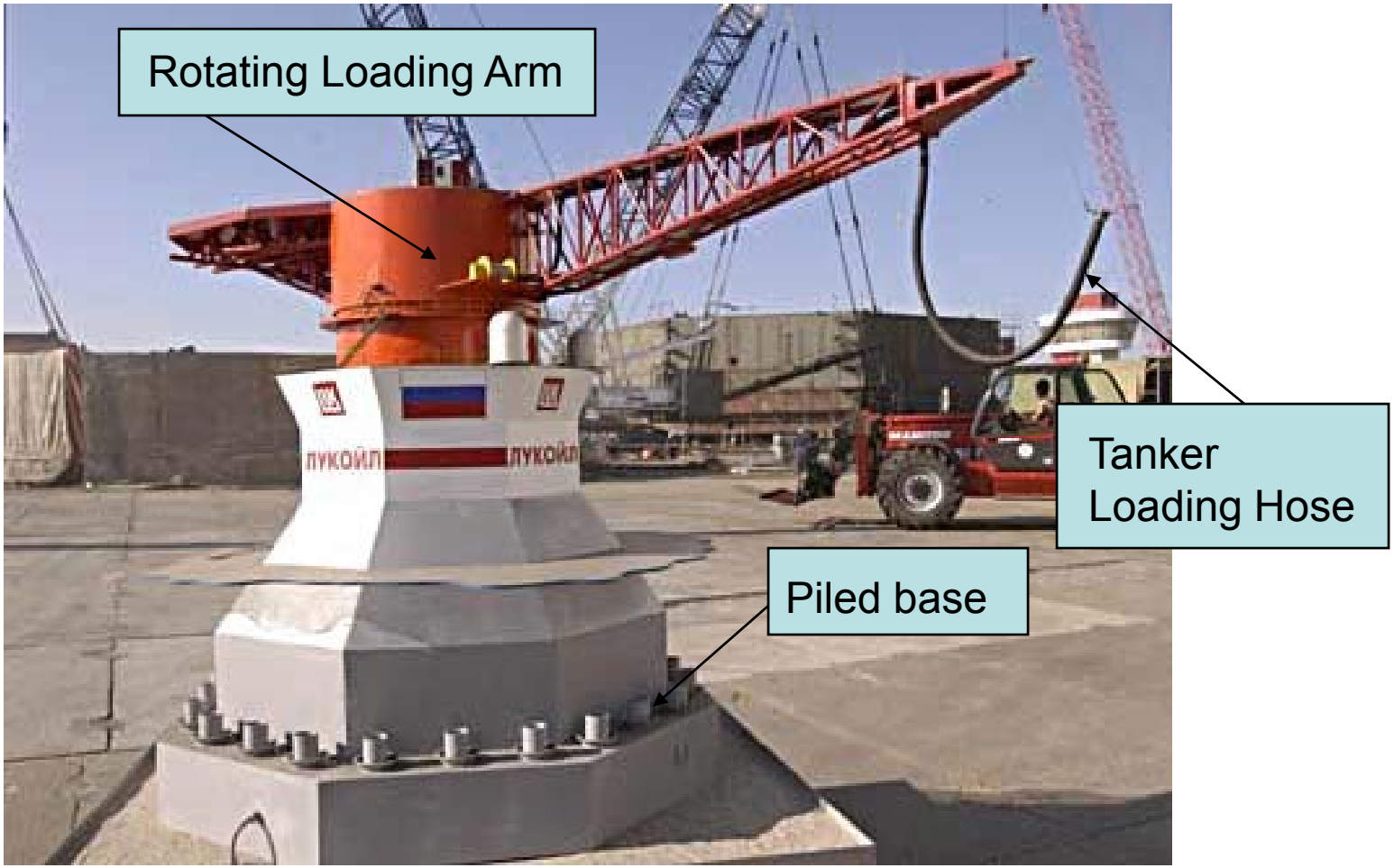
Varandey Oil Export Project



Varandey Transport System

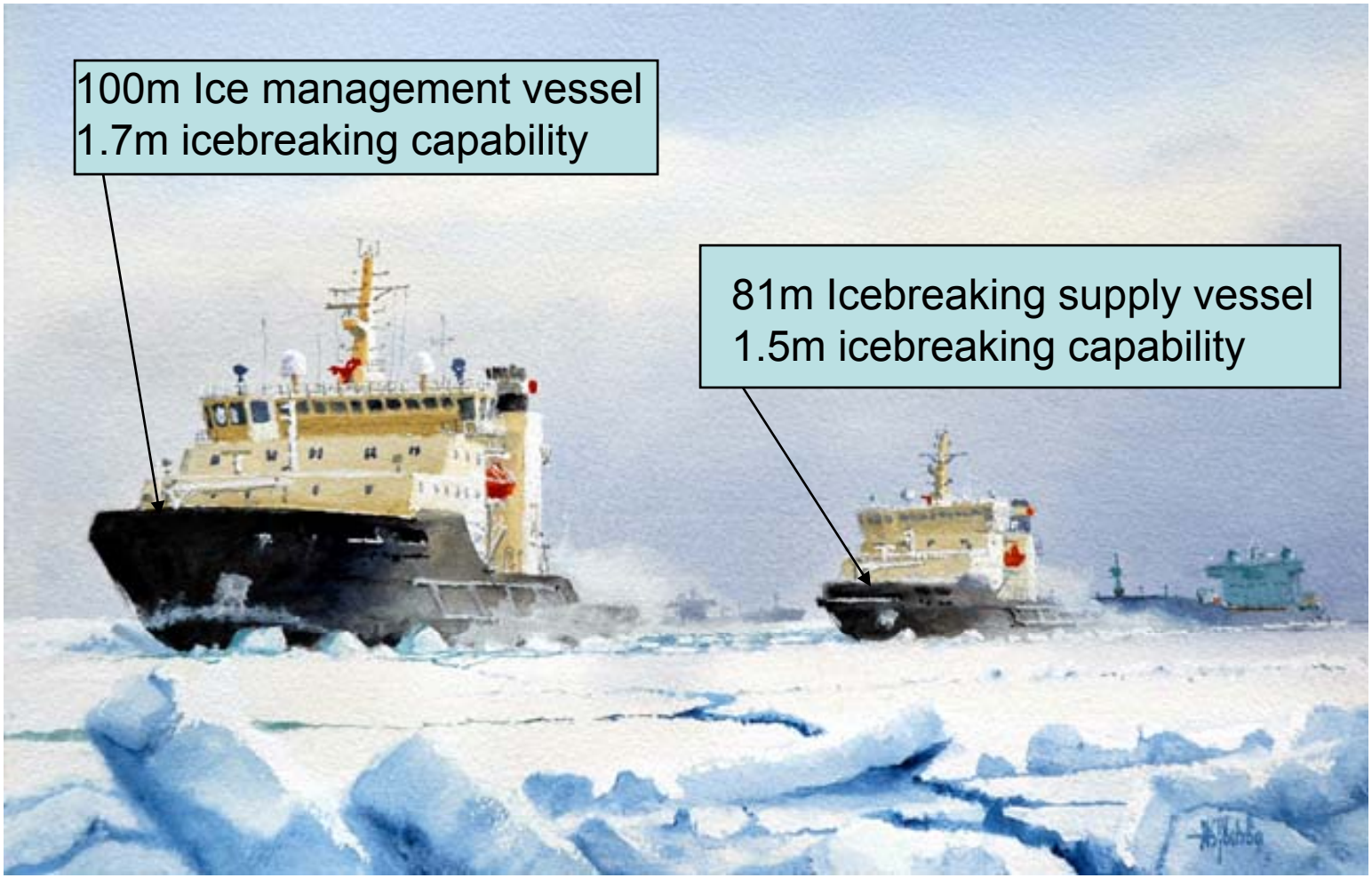


Model of FOIROT – Fixed Offshore Ice Resistant Offtake Structure



FOIROT Base Under Construction

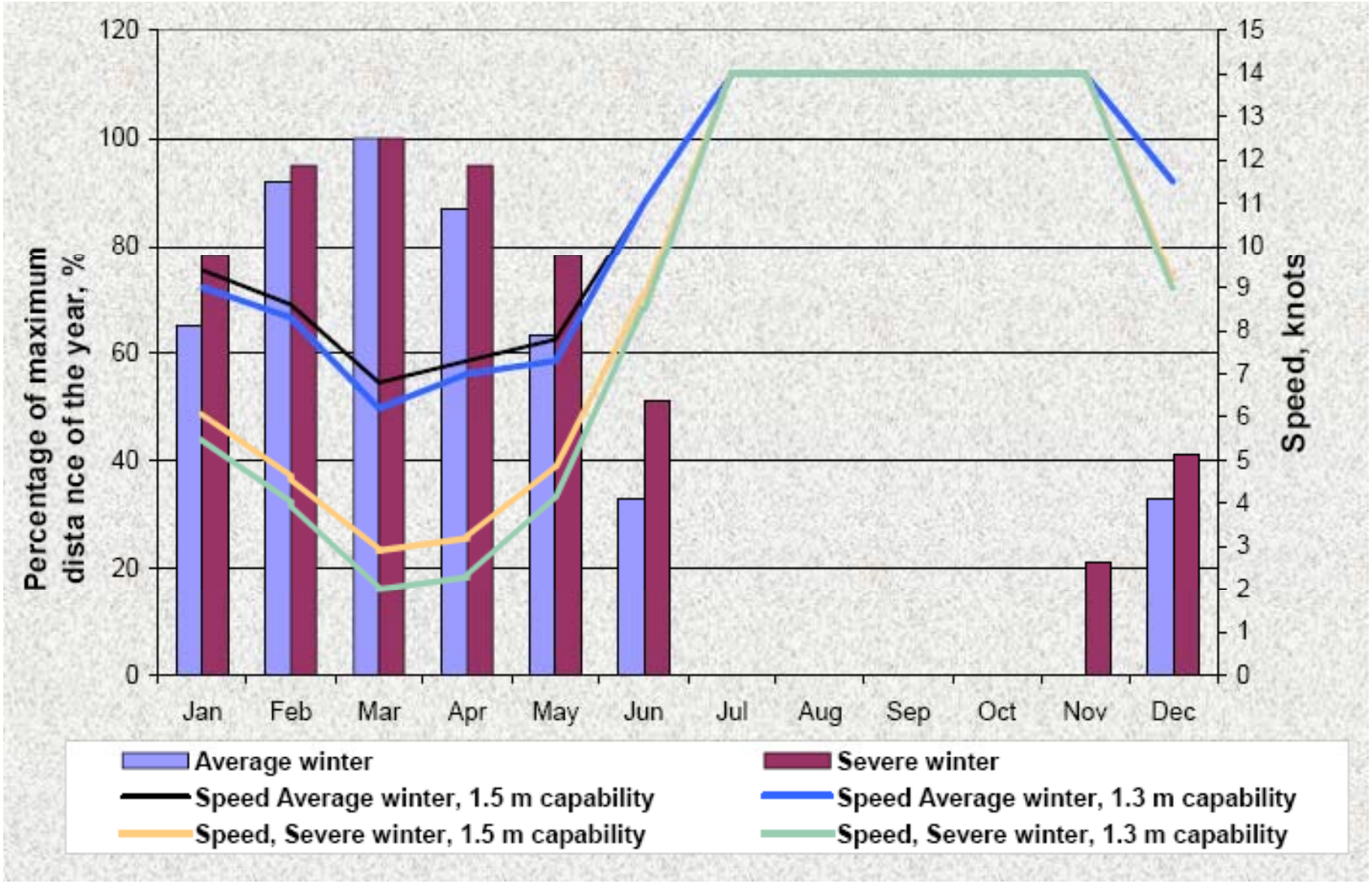
Varandey Icebreaking Service Vessels



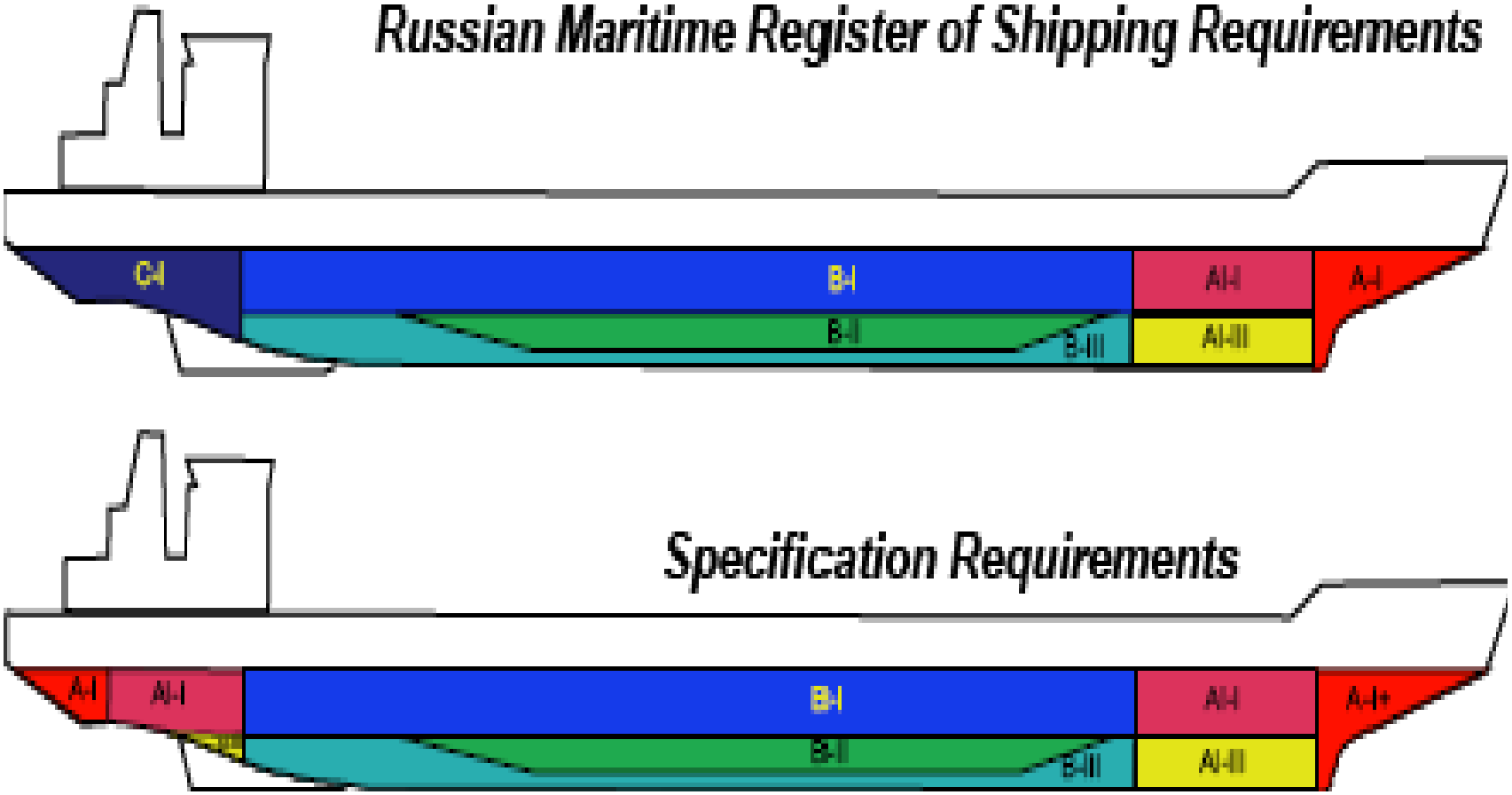
Varandey Project Icebreaking Tankers

- Three (3) icebreaking tankers
  - 70,000 tdwt capacity
  - Under construction in Samsung HI, Koje shipyard
  - Break 1.7m ice continuously
  - 2 x 10MW Tractor Pod propulsion
  - Medium speed diesel prime movers
  - First ship will deliver in Dec 07 Total AFE ~$460MM

Transportation Simulations



Hull Ice Scantlings



Arctic Tanker Construction – SHI, Korea

Keel-laying - ~3000 ton Mega-block Lift

Note:
Keel laying to Launch – 9 weeks

Arctic Tanker Construction – SHI, Korea

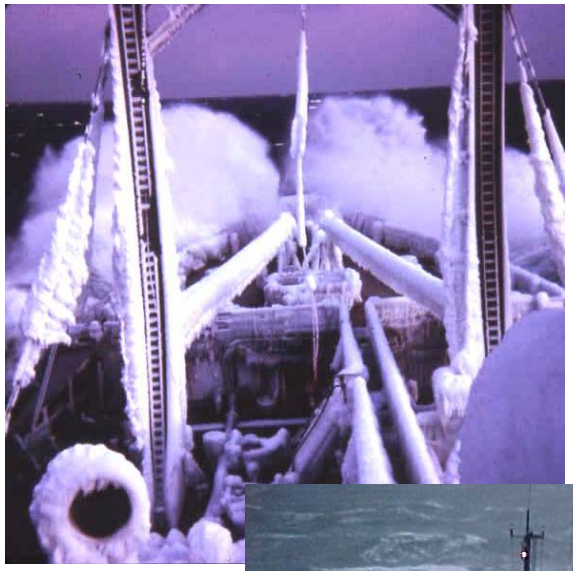
Icebreaking Bow showing Bow Loading Systems

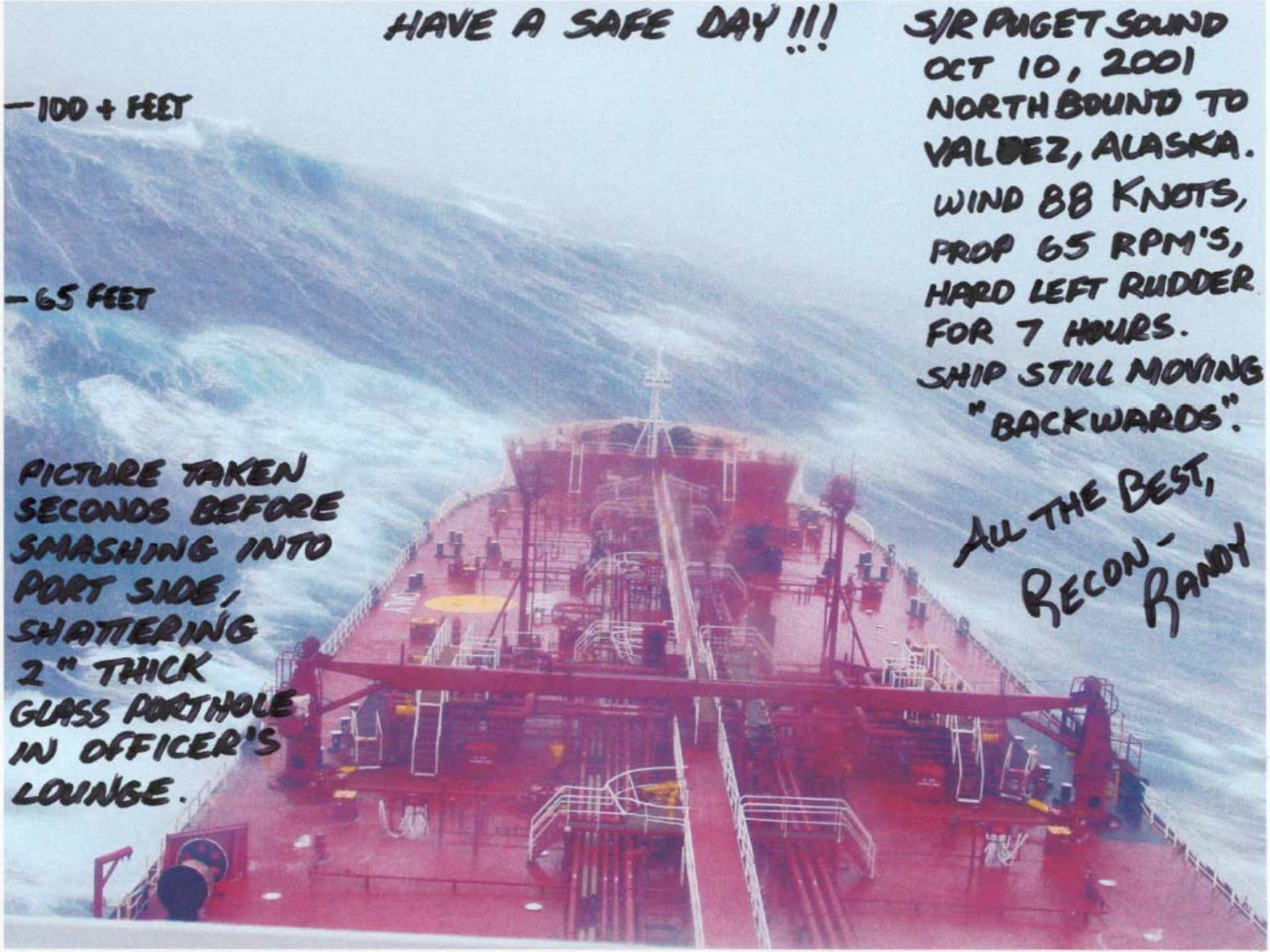
Steel Cutting	Nov 02, 2006
Keel Laying	Apr. 17, 2007
Launching	Jun. 23, 2007
Delivery	Dec. 31, 2007

Arctic Tanker Construction – SHI, Korea
Installation of Electric Pod Propulsors

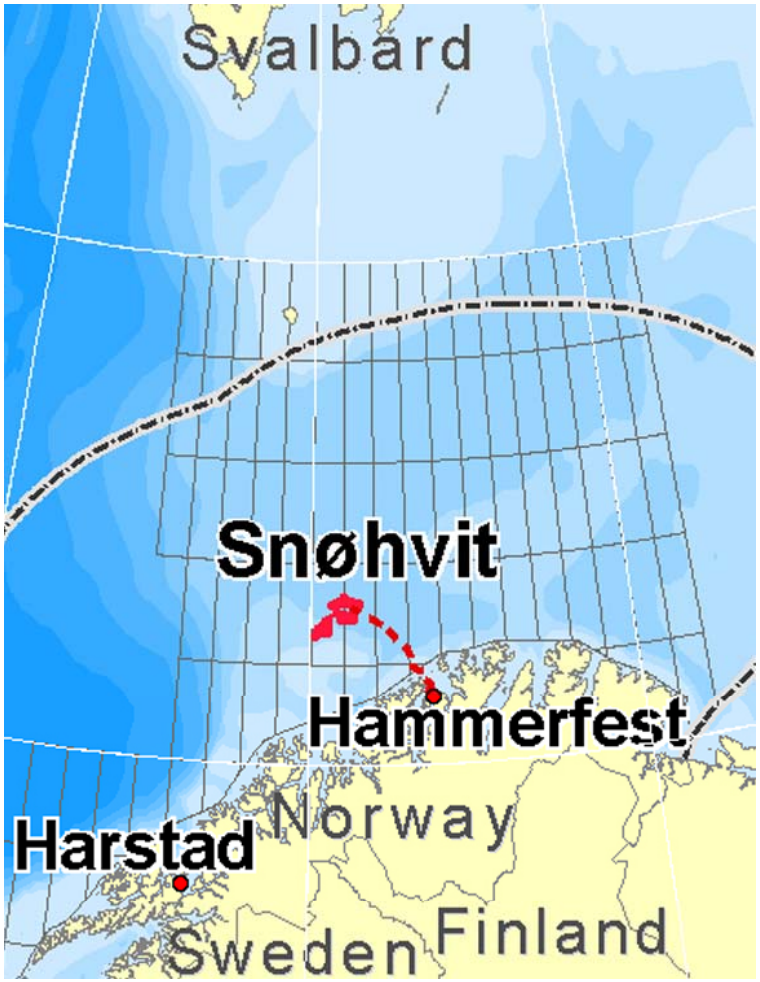
Arctic Navigation – Its not all Ice

- It is not all about breaking ice
- Arctic navigation issues include:
  - Low temperatures
  - Operation in total darkness
  - Superstructure icing
  - Rough water



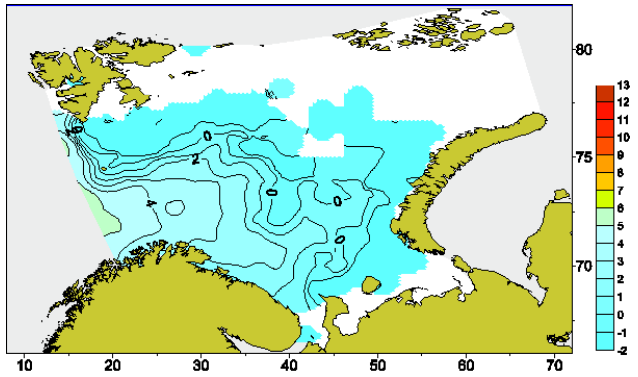

HAVE A SAFE DAY!!!
S/R PUGET SOUND
OCT 10, 2001
NORTH BOUND TO
VALDEZ, ALASKA.
WIND 88 KNOTS,
PROP 65 RPM'S,
HARD LEFT RUDDER
FOR 7 HOURS.
SHIP STILL MOVING
"BACKWARDS".
ALL THE BEST,
RECON-RANDY
-100+ FEET
-65 FEET
PICTURE TAKEN
SECONDS BEFORE
SMASHING INTO
PORT SIDE,
SHATTERING
2" THICK
GLASS PORTHOLE
IN OFFICER'S
LOUNGE.

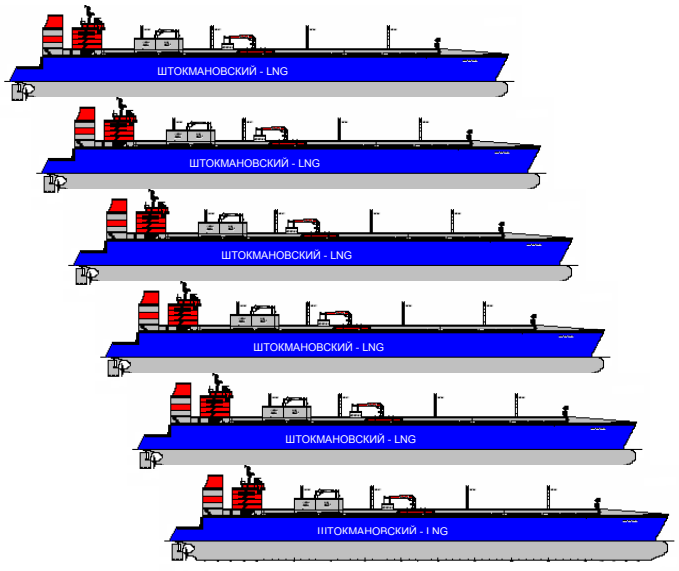
Snohvit LNG – Hammerfest Norway



Shtokman LNG Shipping

- Major FEL 1 Study for Shtokman SLC
  - COP selected to carry out shipping studies on behalf of GazProm and Short Listed Companies
  - LNG production in 2 Phase each of 15mtpa
  - Fleet of ~ 30 ships needed
  - Extremely harsh environment
  - Phase 1 start-up 20??



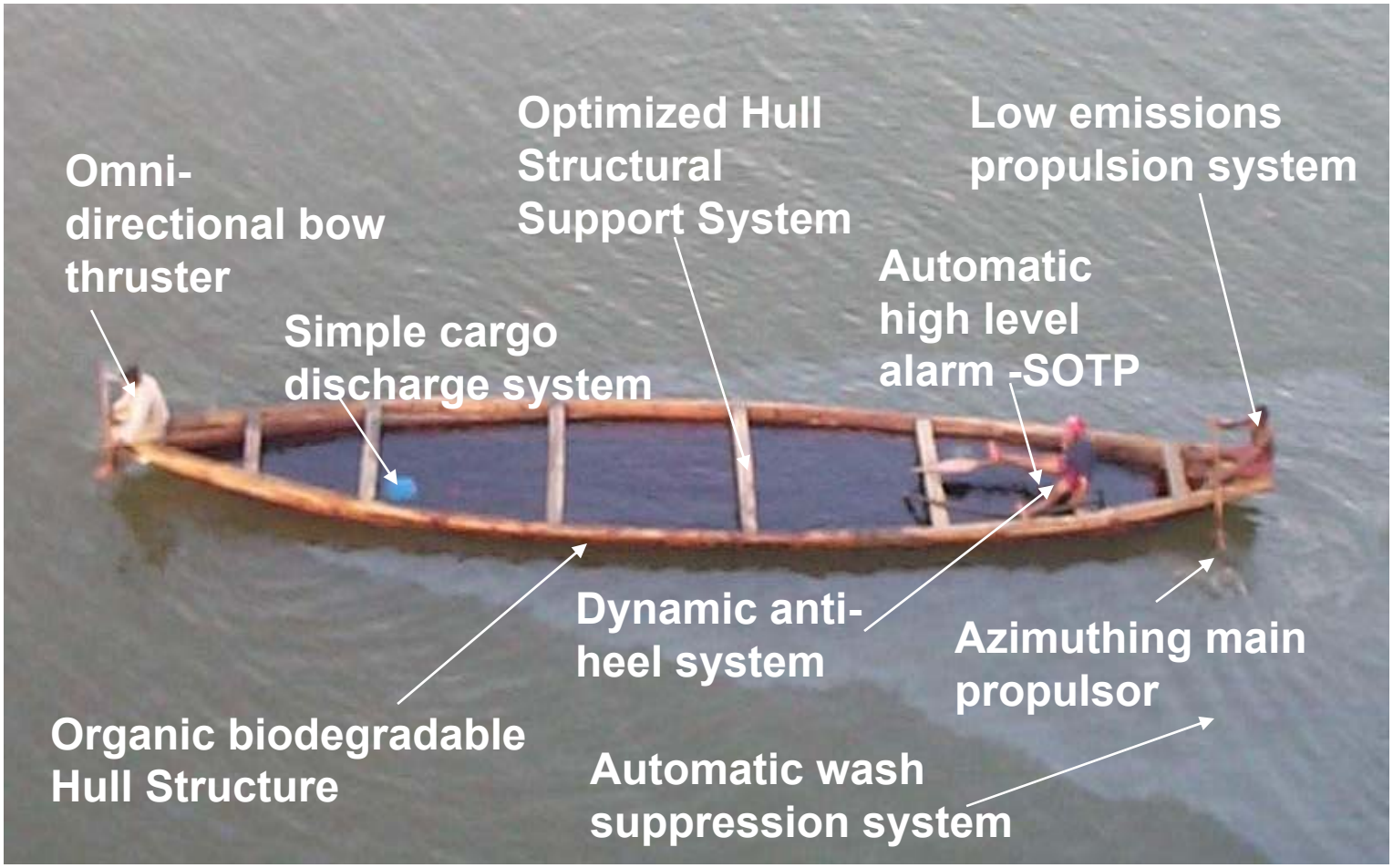


Arctic Naval Architecture Challenges

- More than for any other service – for Arctic service it is important to *"design the right ships"* before we start to *"design the ships right"*
- Ships and offshore systems must have good performance in ice and open water
- Ships and offshore systems must be efficient, reliable, cost effective and environmentally sound.
- Ships and offshore systems may not have much infrastructure support, e.g. bunker ports, dry-dock facilities, etc, so must be as self sufficient as possible for day to day operations
- Ships should have high dwt capacity but shallow draft
- Ships should be high powered, but fuel efficient
- Navigation and communication systems in the Arctic are more challenged than in southern waters
- Availability of external resources for search and rescue, firefighting, towing and salvage are very limited, so again ships and marine systems must be as self sufficient as possible for emergency operations
- Crew habitability and working conditions must be good in regions of total darkness, high noise (icebreaking), extremely low temperatures, atmospheric and spray icing, etc

Plan B – Just in case all the ice disappears

Riverine Oil Tanker, Nigeria, Project ROT-N



Note: SOTP is "seat of the pants" sensor system