Beaufort Sea: Exploration To Production

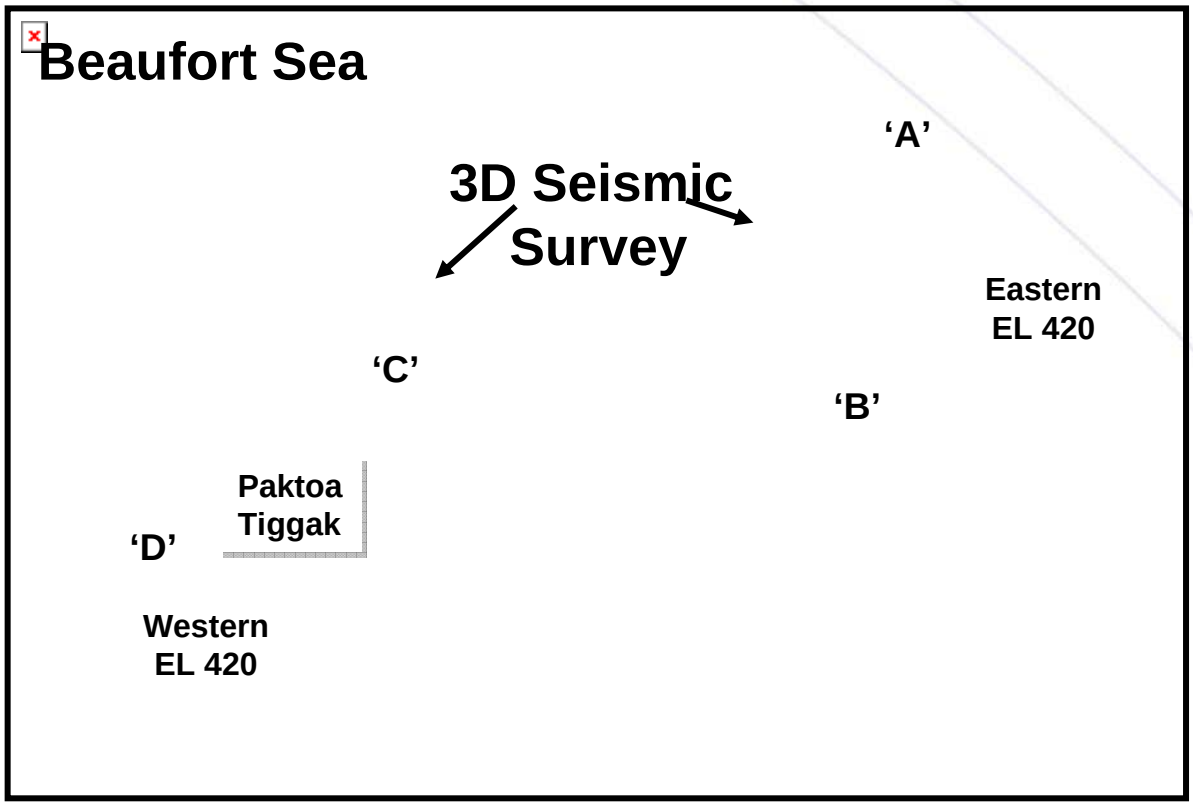
Presented by
Devon Canada
to
S.N.A.M.E.

June 20th, 2005

Agenda

- Exploring the Beaufort Sea
  - *Devon's EL 420*
  - *Exploration Targets*
  - *Drilling Season*
  - *Drill System Selection*
  - *Impacts of Declining Infrastructure*
- What Happens with a Discovery?
- Fitting Development Concepts to the Beaufort
  - *Offshore Developments*
  - *Beaufort Design Constraints*
  - *Adapting Development Core Elements*
  - *Future Innovations*

Devon Canada's EL 420

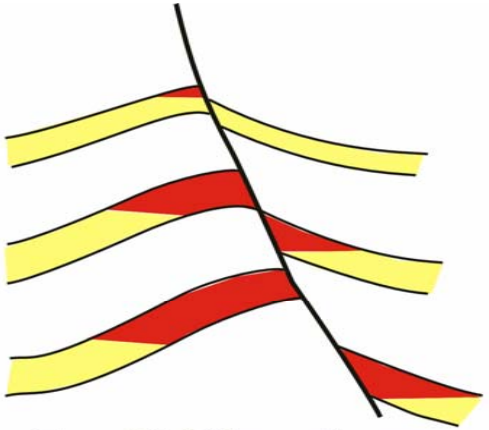


- EL 420 overlays the near-shore Beaufort Sea
- Water depths ranging from 0 m to 24 m
- Annual temp's ranging from -45ºC to +28ºC
- Predominantly within the stable landfast ice region
- First well will be drilled during the 2005/06 winter season

North Sea Block

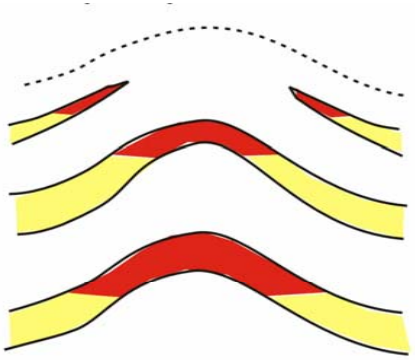
Gulf Of Mexico Block

Exploration Targets



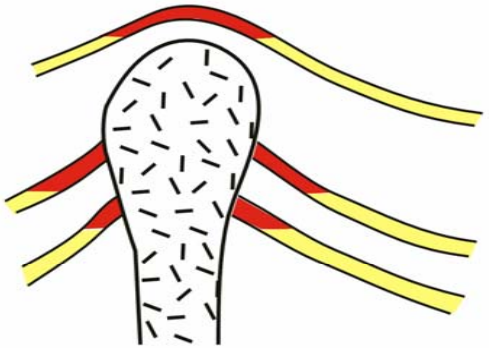
Fault Structure

- proven in basin (Amaul, Taglu, Issung)
- 5 prospects on Devon land



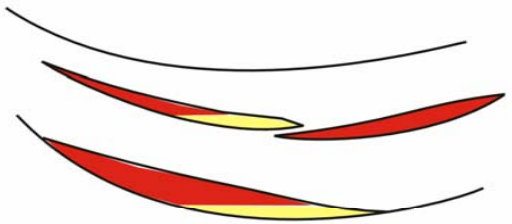
Four-Way Structure

- proven in basin (Nig, Adgo)
- 2 prospects on Devon land



Diapir Flank

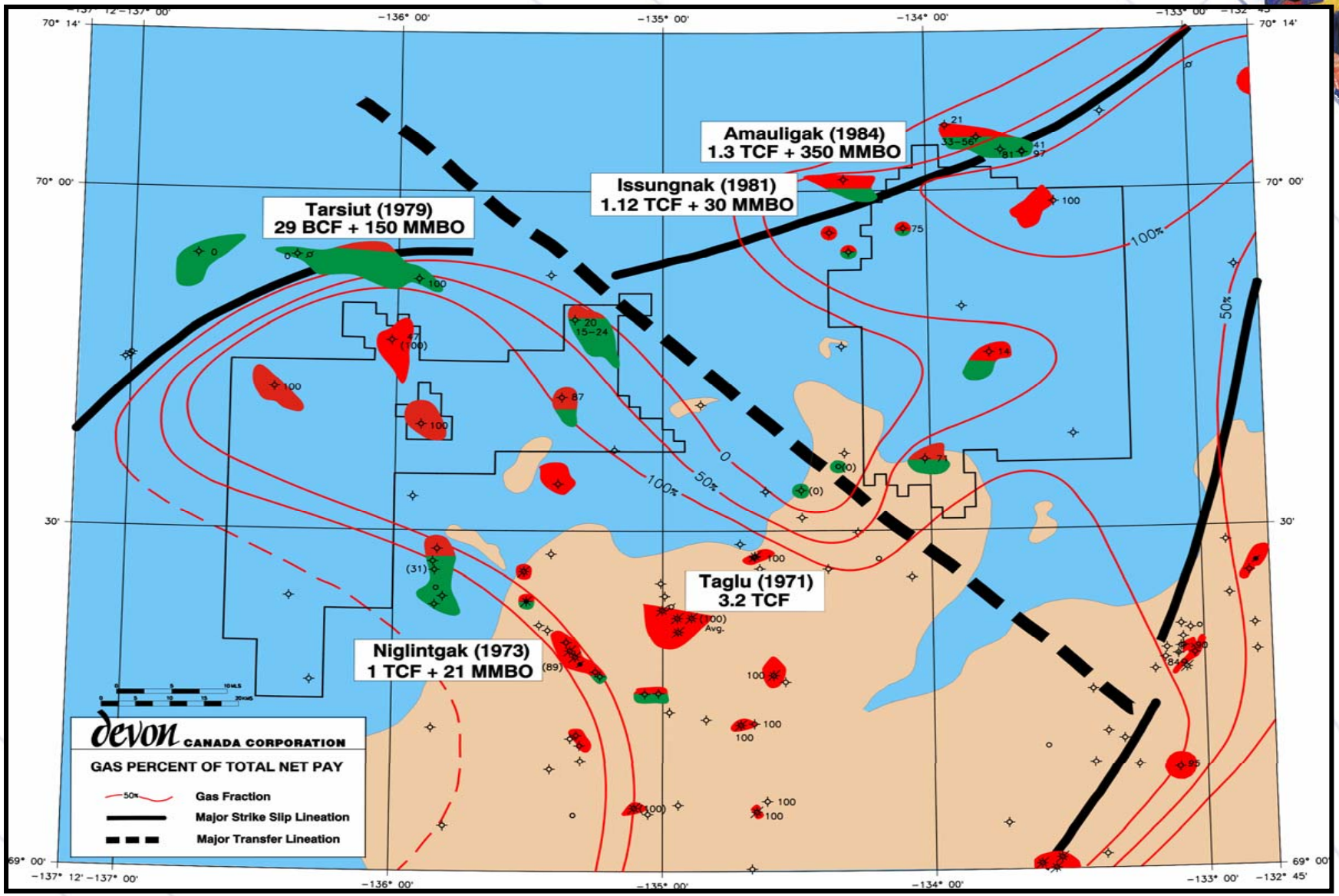
- untested in basin
- 2 prospects on Devon land



Turbidite Sequences

- untested in basin
- 2 prospects on Devon land

Exploration Targets: Gas Regions



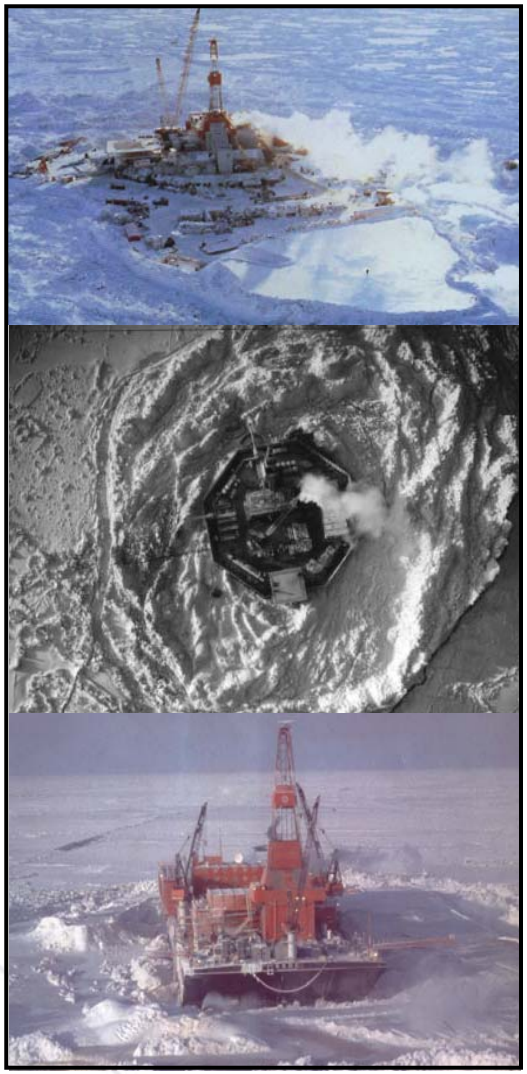
Summer Vs. Winter Drilling

SUMMER DRILLING

1st Qtr	2nd Qtr	3rd Qtr	4th Qtr

- Limited open water season for floating vessels of ~ 100 days dependent on ice conditions and available ice class support
- The short summer operating season is really only suitable for the drilling of relatively shallow targets
- The effective season length can be subject to significant variation on a year by year basis due to ice conditions

Summer Vs. Winter Drilling



WINTER DRILLING

1st Qtr	2nd Qtr	3rd Qtr	4th Qtr

- A drilling season of between 110 - 150 days is available & thus suitable for the drilling & evaluation of deeper targets
- Operations are essentially insensitive to weather conditions
- Drill systems need to be totally self sufficient in terms of drilling consumables / fuel

Summer Vs. Winter Drilling

Devon's exploratory drilling program will be completed within the landfast ice zone which offers the following benefits:

- A stable, well known operating environment
- A longer drilling season than the summer
- In the unlikely event of an accidental spill, the landfast ice provides a friendlier surface on which to conduct clean-up operations.
- The winter drilling period presents limited impact to migratory species such as birds and whales

Drilling System Selection

Floaters		✗
Molikpaq		✗
CIDS		✗
Tarsuit CRI		✗
Esso CRI		✗
Islands		✗

SDC

✓

Ice Islands

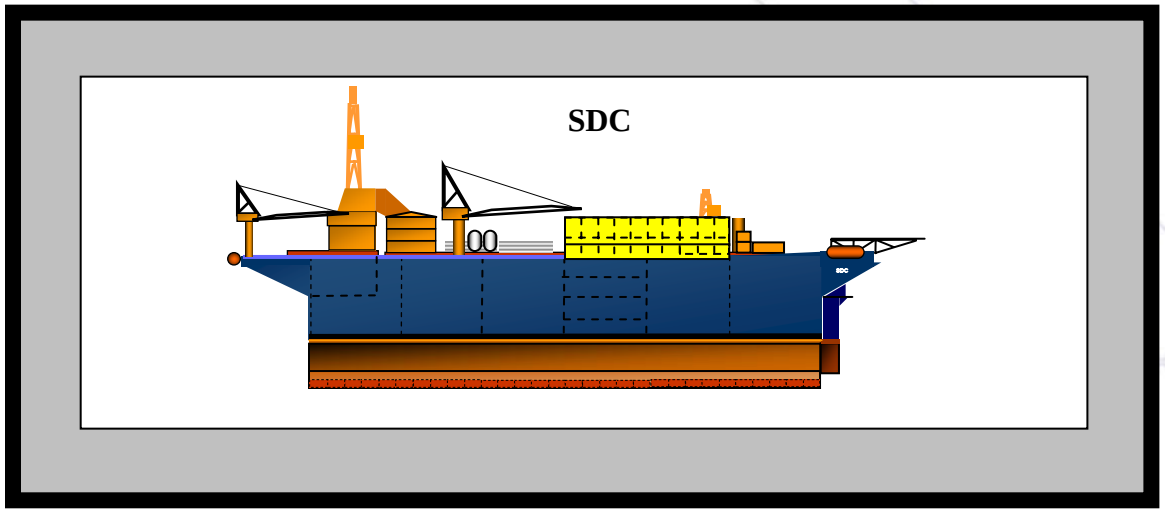
✓

SDC: General Information

SDC (Upper Structure)

- **SDC** - formally the SSDC (Single Steel Drilling Caisson)
- Fabricated in Japan and mobilized to the Beaufort in 1982
- Classed with ABS (*American Bureau of Shipping*) as a MODU (*Mobile Offshore Drilling Unit*).
- The **SDC** is the converted fore body of the VLCC "World Saga" (232,134 Dead Weight Ton Oil Tanker)
- Reinforced with 3.3' (1 m) thick concrete and extra steel supports
- **SDC II (Lower Structure)**
- SDC II formally the **MAT**
- Constructed in Japan and mobilized to the Beaufort in 1986
- Classed with ABS as a Submersible Barge
- EH36 modified low temperature steel construction throughout
- 6.6' (2m) long box type skirt covering the total base of the system to provide sliding resistance

SDC: General Information



Length at deck	662 ft
Width at base	361 ft
Deck area	110,000 sq.ft
Lightship weight.	80,000 tons

Length overall	910 ft
Max width	147 ft
Deck area	90,000 sq.ft
Lightship weight.	27,000 tons

SDC: Drilling History

Date	Well	Water Depth m	Water Depth ft	Comments
1982/83	UVILUK P-66	31	102	Hull on berm (Canada)
1983/84	KOGYUK N-67	28	92	Hull on berm (Canada)
1986/87	PHOENIX	18	60	Hull & Mat on sea floor (US)
1987/88	AURORA	21	69	Hull & Mat on sea floor (US)
1990/91	FIREWEED	16	53	Hull & Mat on sea floor (US)
1991/92	CABOT	17	56	Hull & Mat on sea floor (US)
2002/03	MCCOVEY	10	35	Hull & Mat on sea floor (US)

SDC - Risks

Weather Related Risks:

- Minimal

Marine Related Risks:

- Significant mob / demob' costs due to lack of easily available icebreaker support

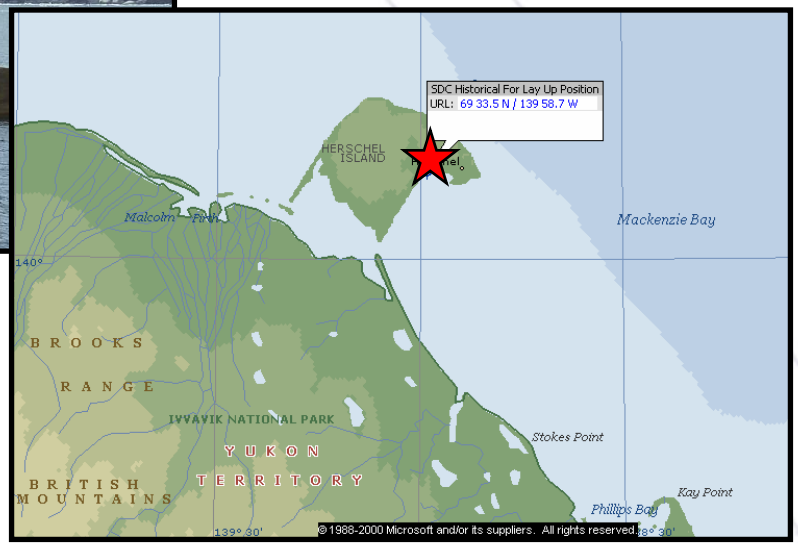
Risk Drilling Days (~150 days)

Simple System but Expensive

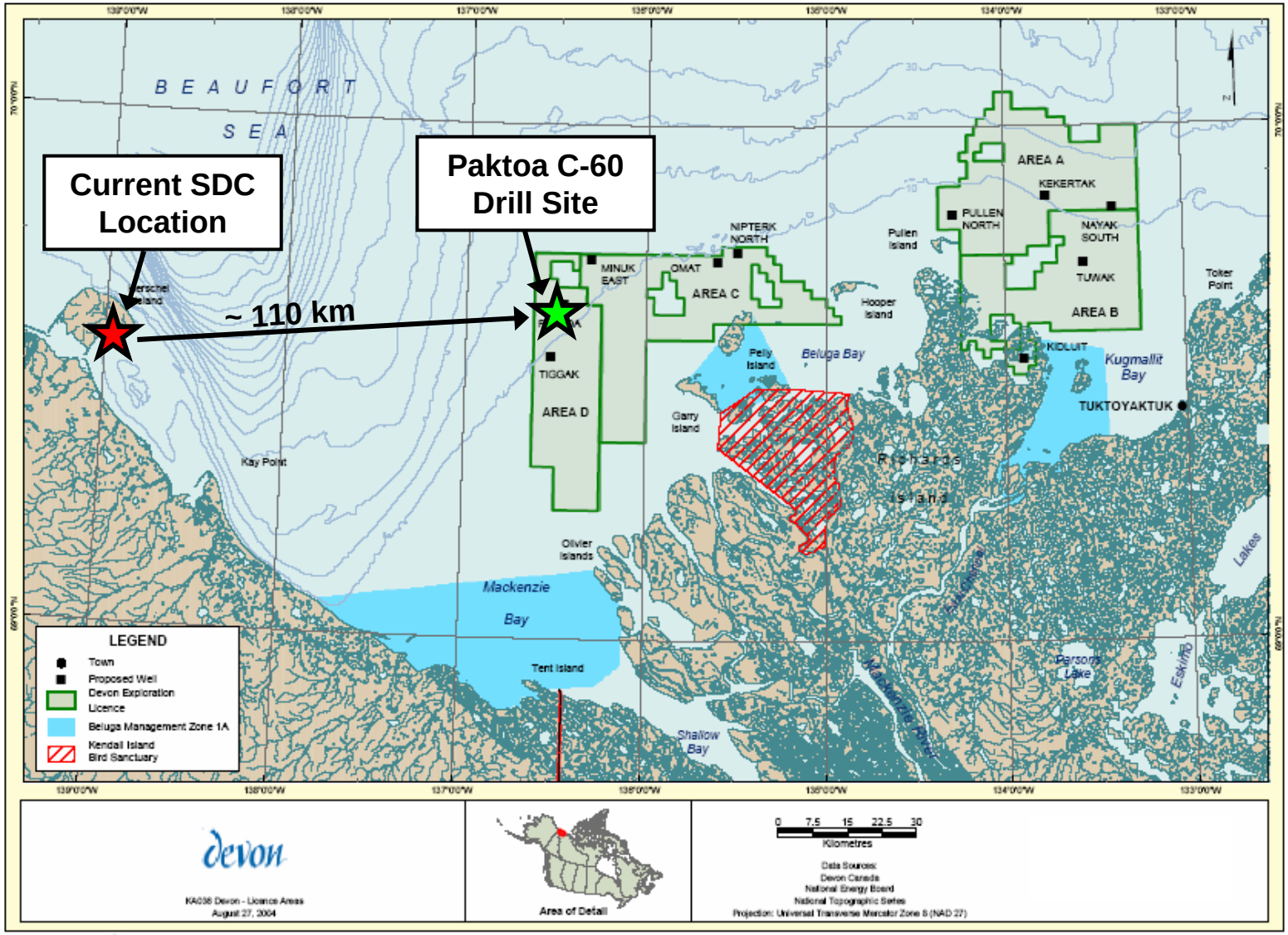
Declining Infrastructure:
Marine Vessels

- Canmar fleet dismantled
  - One Class 4 icebreaker
  - One Class 3 supply vessels
  - Seven Class 2 supply vessels
- Beaudril fleet dismantled
  - Two Class 4 icebreakers
  - Two Class 4 supply vessels
- ATL fleet dismantled
  - Two Class 2 supply vessels
  - Numerous ice strengthened vessels
- NTCL fleet dismantled
  - Numerous ice strengthened vessels

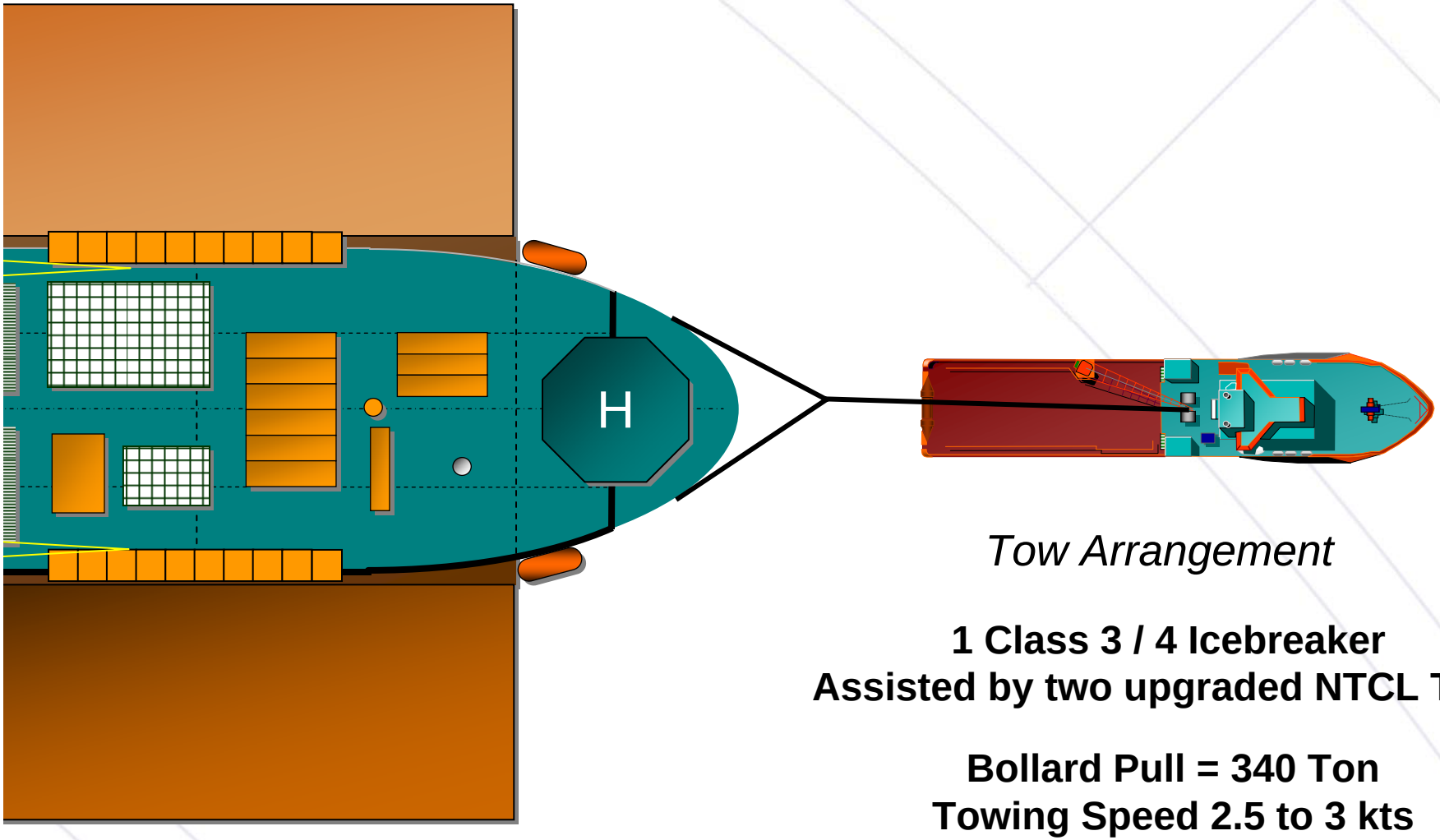
SDC – Herschel Anchorage



2005: SDC Mobilization



SDC - Tow Arrangement

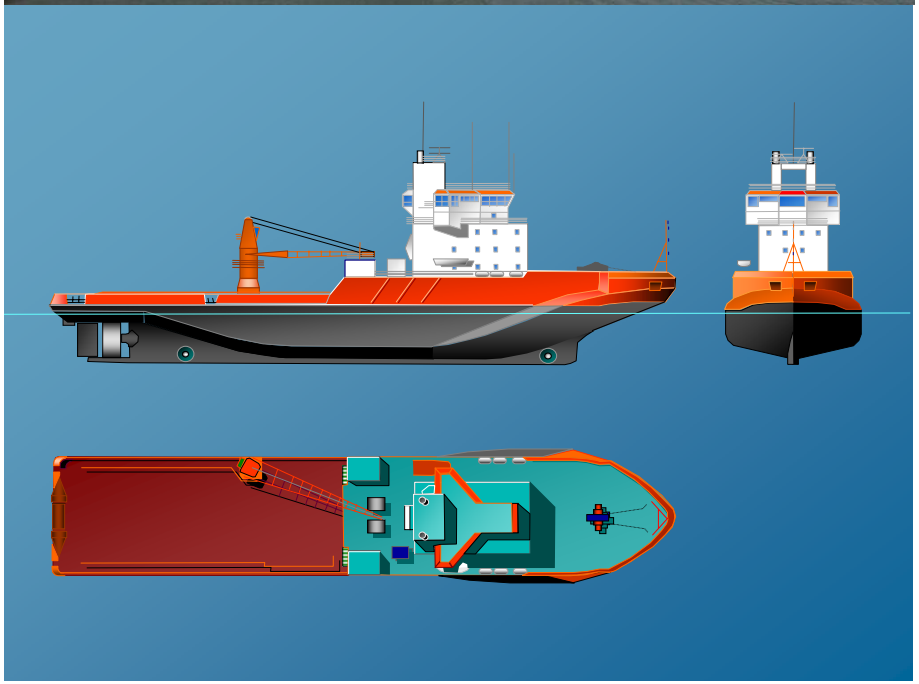


Tow Arrangement

1 Class 3 / 4 Icebreaker
Assisted by two upgraded NTCL Tugs

Bollard Pull = 340 Ton
Towing Speed 2.5 to 3 kts

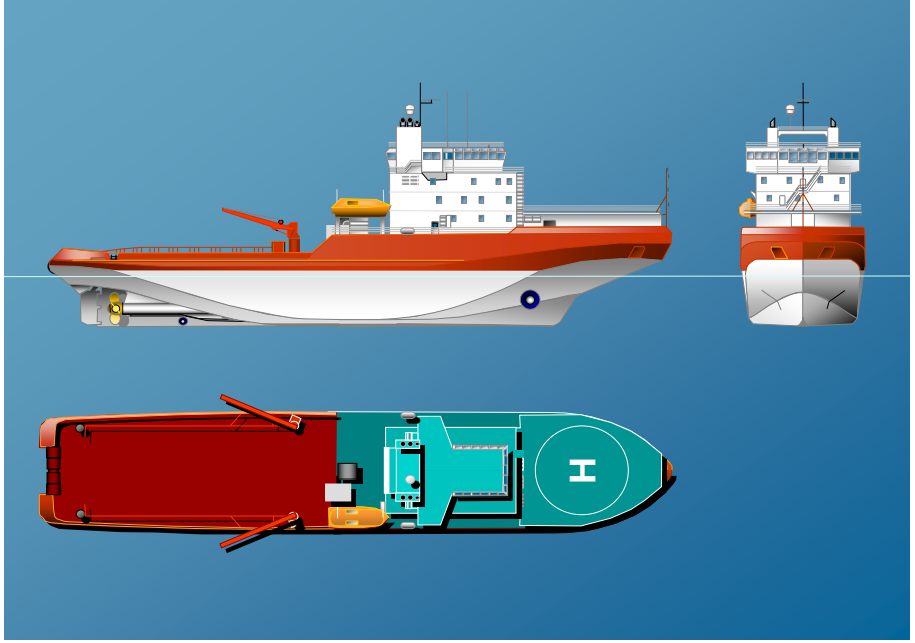
Icebreaking AHTS – MV Talagi



Bollard Pull:	**196 T**
Ice Class:	**CASPPR Arctic Class 4**
Working Draft:	**7 to 8.5 m**
Max Deadweight:	**1890 T**
Built:	**1979, St. John Shipbuilding & Drydock Co. Ltd., St. John, N. B., Canada**
Day Rate:	**$16,500 US (estimated)**
Current Location :	**Sakhalin Island**
Owner:	**Smit International**
Contact:	**Capt. Duijfjes Smit Wijs Westplein 513 3016 BM Rotterdam The Netherlands (+31-10) 412 69 69 aduilfjes@smitwijs.com**
Hull Overall Dimensions:	**80.72m L x 19.25m B x 10.06m D**
Cargo Deck:	**27m x 7m Aft, 590 T**
Bulk Tanks:	**Removed**
Propulsion:	**Single nozzle CPP**
Propulsion Horse Power:	**16,800 BHP**
Thrusters:	**Bow & Stern: CPP, 1200 HP each**
Max. Fuel Consumption:	**60 m3 per Day**
Usable Fuel Capability:	**1200 m3 (MDO)**
Accommodations:	**14 crew + 28**
Cranes:	**1 x 20 T @ 3.2m, 8T @ 16.8m**
Helicopter Deck:	**Aft Deck only**

J.C. & A., Jan. 2005

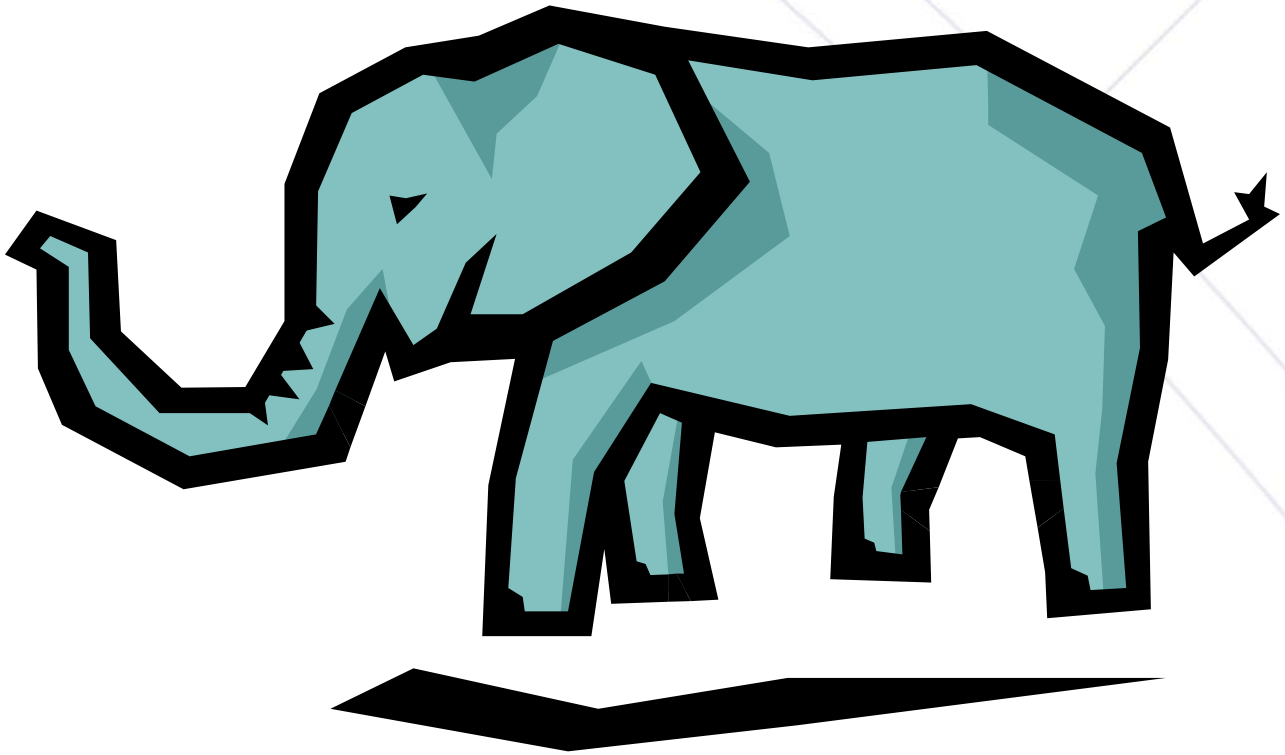
Icebreaking AHTS – MV Arctic Kalvik



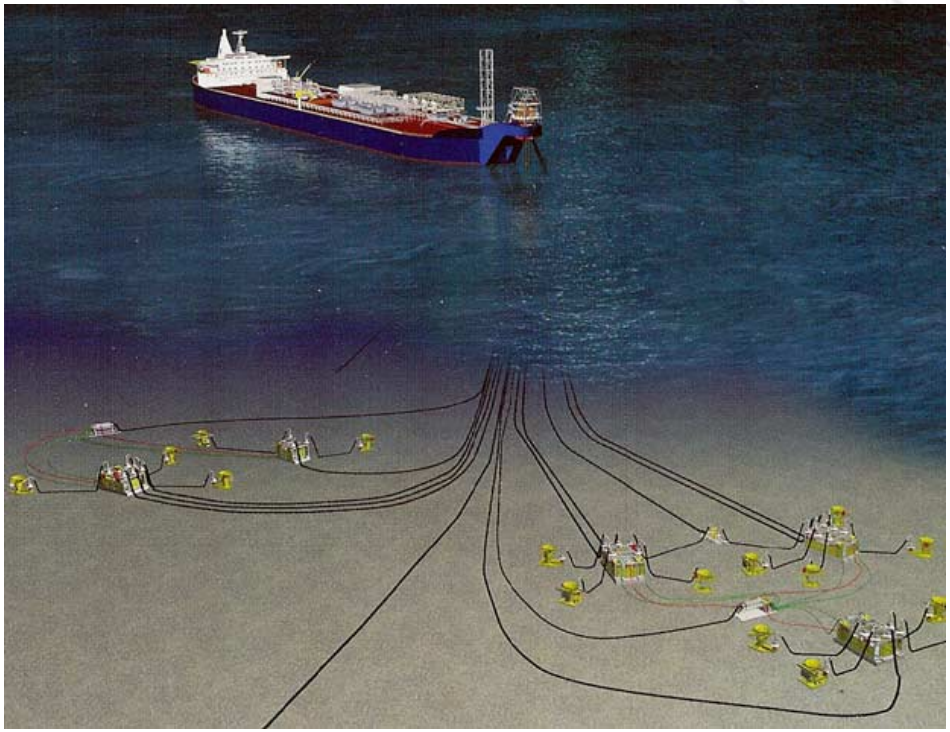
Bollard Pull:	**220 T**
Ice Class:	**CASPPR Arctic Class 4**
Working Draft:	**7 to 8.3 m**
Max. Deadweight:	**1933 T**
Built:	**1983, Burrard Yarrows Co., Victoria, B.C., Canada**
Day Rate:	**$25,000 to $30,000 US estimated**
Current Location :	**North West Russia**
Owner:	**Murmansk Shipping Co.**
Contact:	**Elmar Kamaev Murmansk Shipping Company 15, Kominterna Str. Murmansk, 183038 Russia +7 (8152) 481 489 KamaevEL@msco.ru**
Hull Overall Dimensions:	**88m L x 17.8m B x 9.1m D**
Cargo Deck:	**37m x 13m Aft, 800 T**
Bulk Storage:	**?**
Propulsion:	**Twin open screws / single rudder**
Propulsion Horse Power:	**23,500 HP**
Thrusters:	**Bow: CPP 18 T; Stern: CPP 5 T**
Max. Fuel Consumption:	**65 m3 per Day**
Usable Fuel Capability:	**1760 m3 (MDO)**
Accommodations:	**24 crew + 10**
Cranes:	**2 x 5T**
Helicopter Deck:	**Forward**

J.C. & A., Jan. 2005

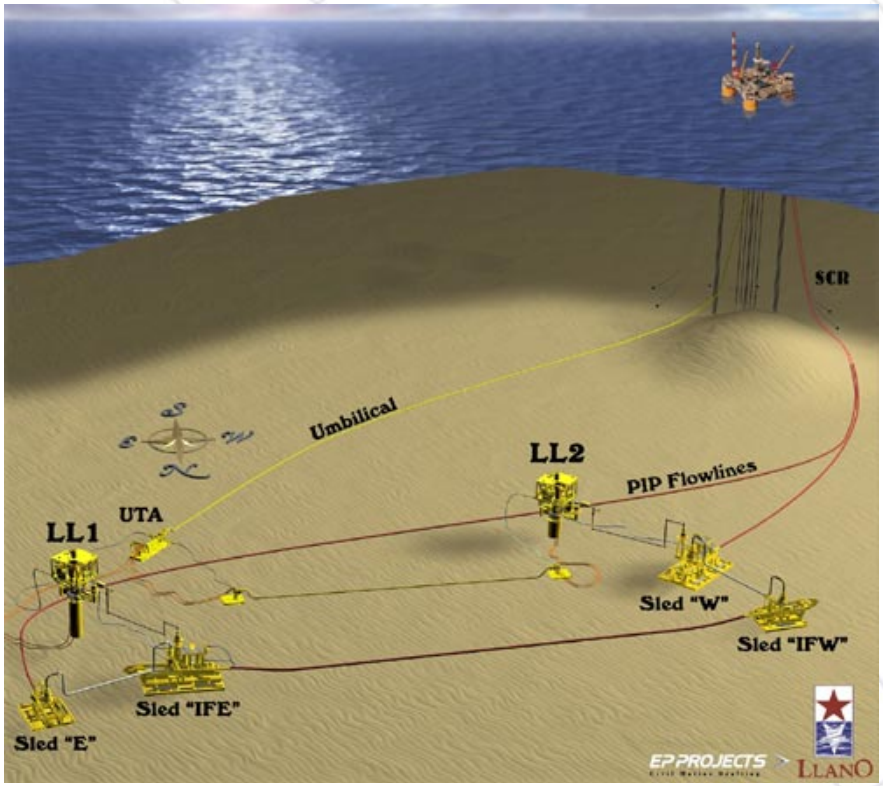
What Happens With A Discovery?



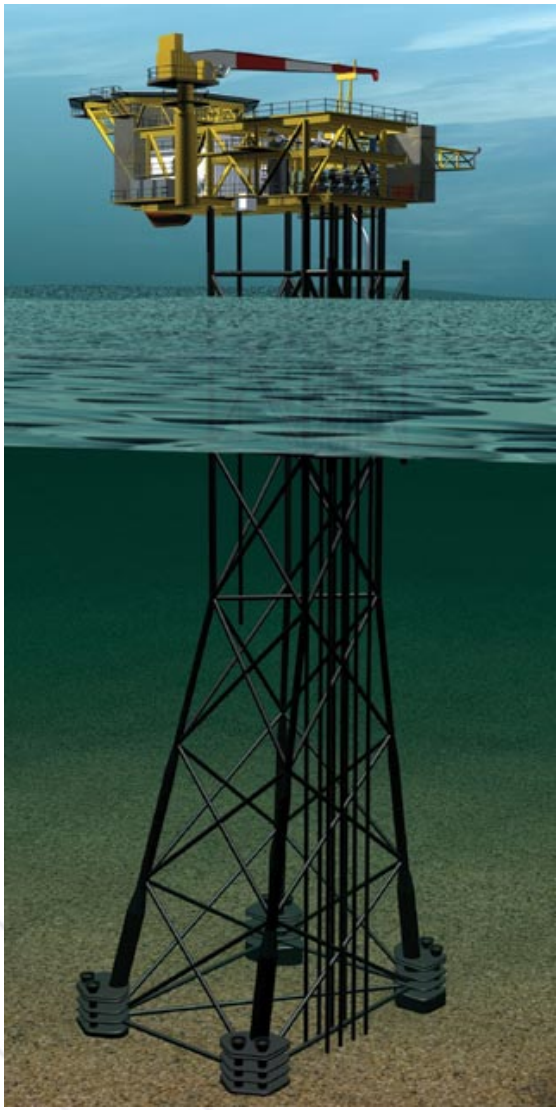
Offshore Developments



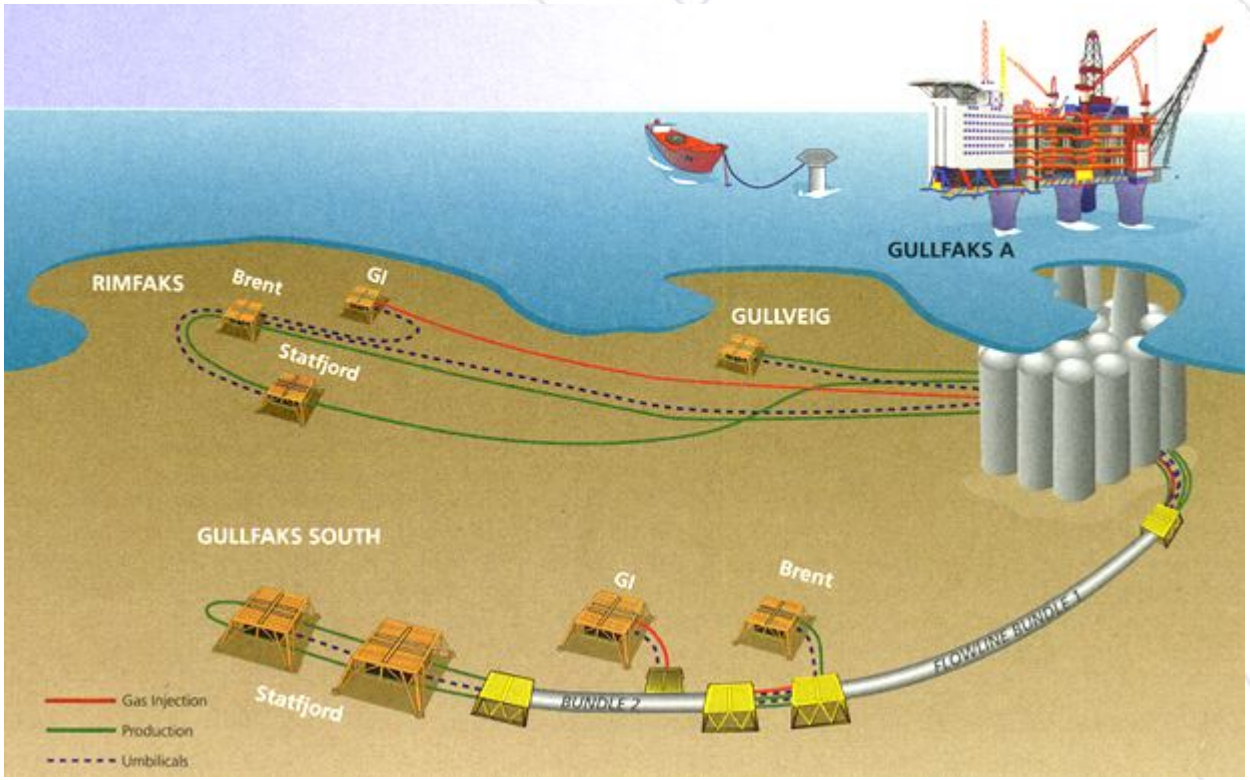
Deeper Water Developments



Offshore Developments



Shallower Water Developments

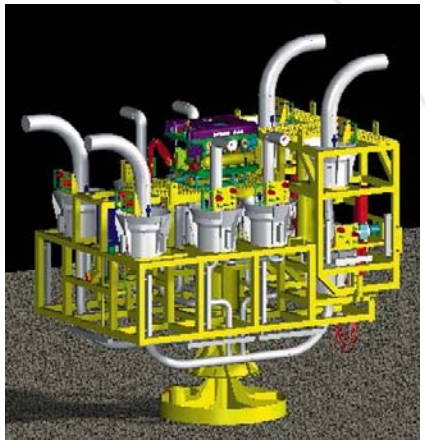


Offshore Developments: Core Elements

Central Production Platforms

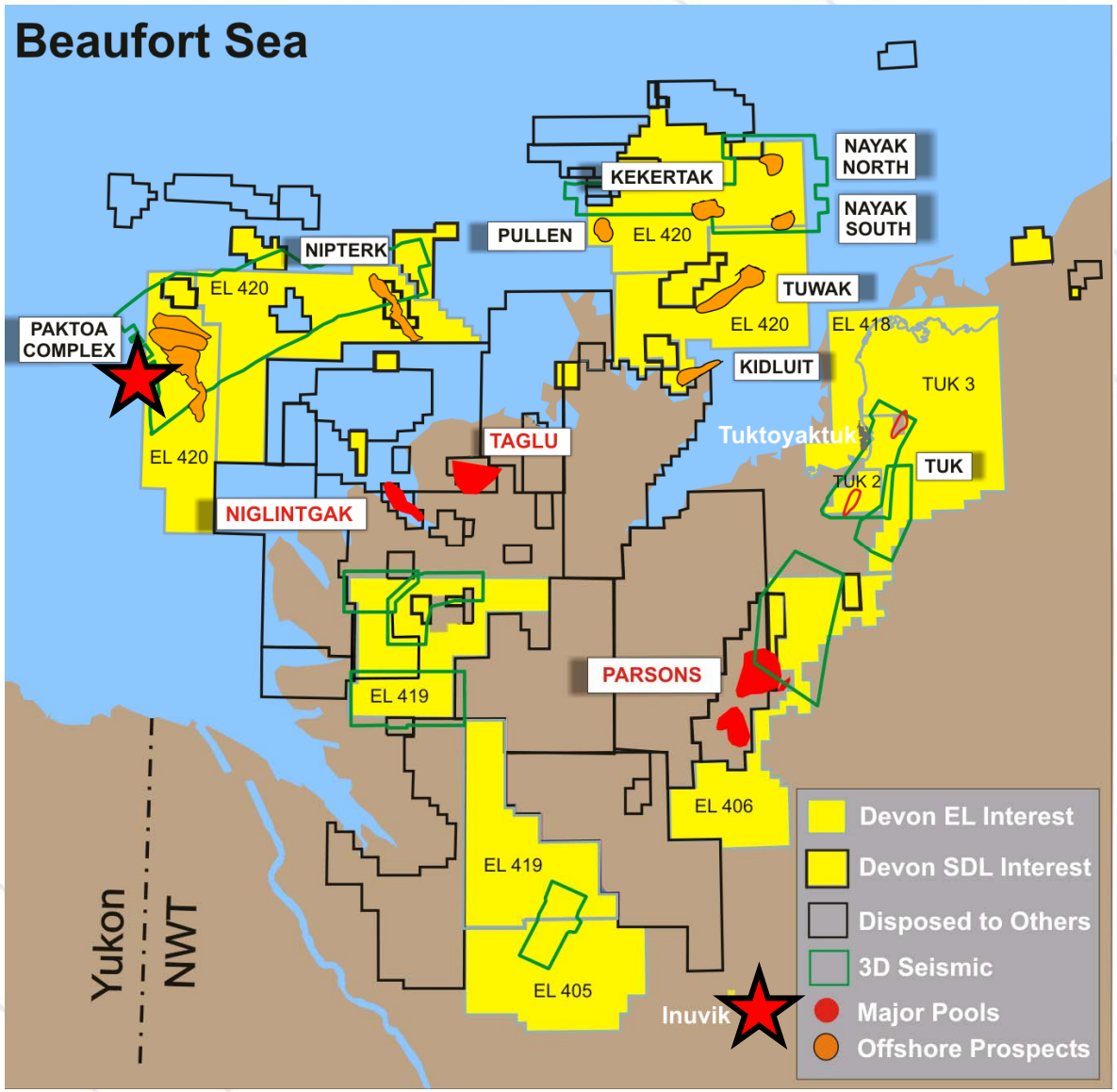
Subsea Wellheads & Templates

Pipelines & Tie-Backs



Subsea Manifolds & Production Hubs

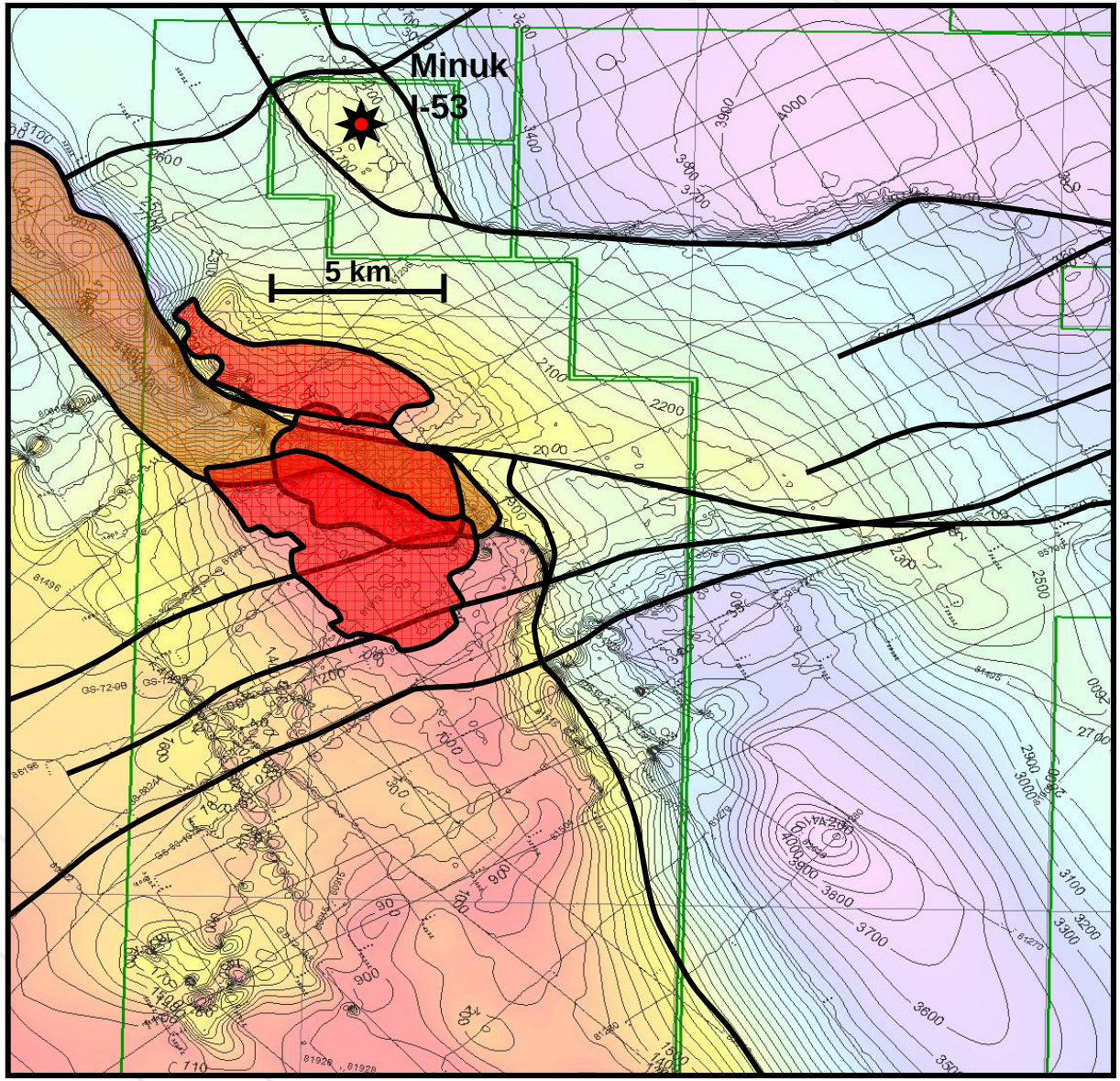
Physical Constraints



Relationship to Infrastructure

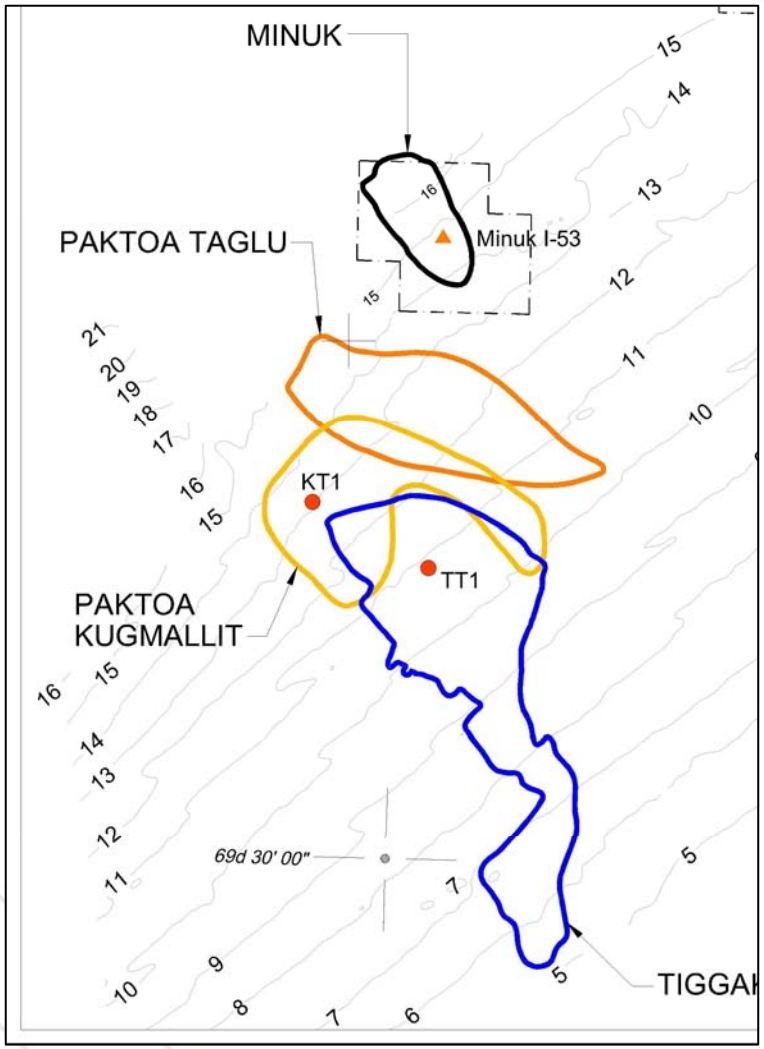
Gathering Systems, Facilities & Pipelines

Physical Constraints: Geometry



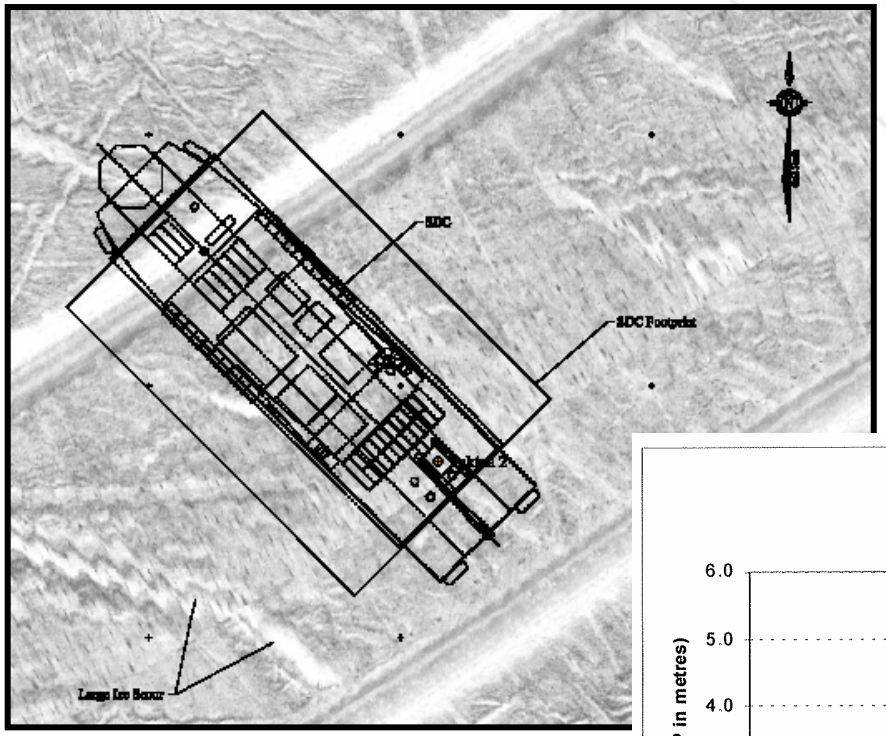
- **Prospect geometry eliminates the possibility of developing from a central location**
- **The deeper zones may be significantly offset to shallower zones**
- **The geometric disparity is enhanced as the resource grows in size**
- **Multiple stacked sands influence well bore trajectories & locations**

Physical Constraints: Water Depth

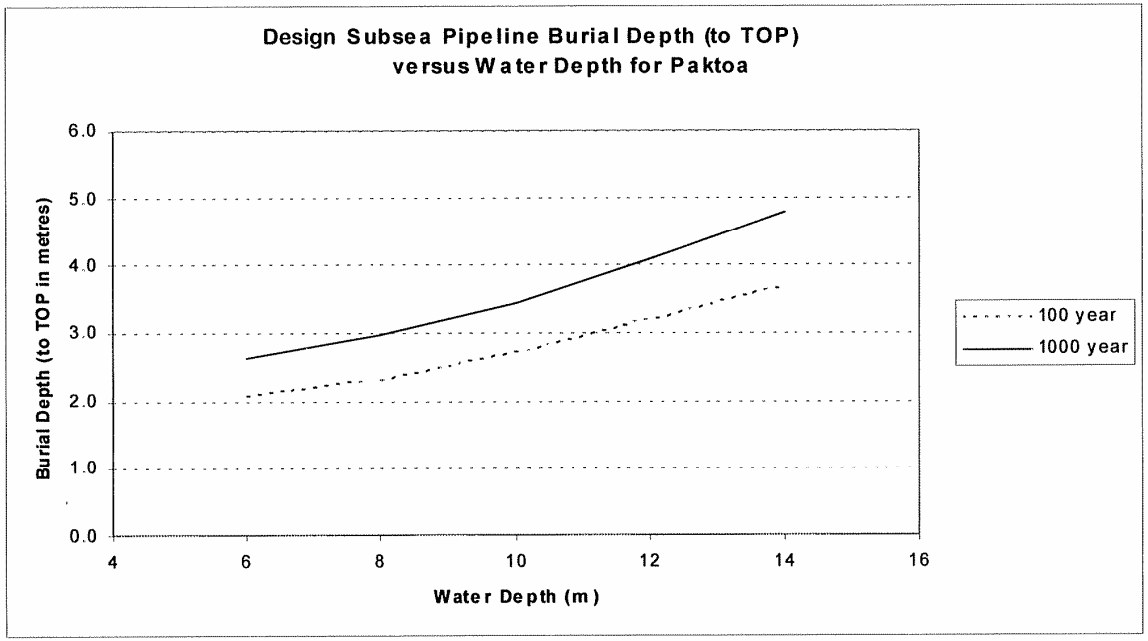


- **Water depth has many implications:**
  - **Shallow water limits use of drill systems, marine support, crane barge size, supply vessel size etc.**
  - **Eliminates the use of floating drill systems**
  - **Deep enough to make artificial islands prohibitive**
  - **Deep enough to make ice scour a significant issue**
  - **Not deep enough to eliminate ice scour**
  - **Benign land fast ice regime half the year**

Physical Constraints: Ice Scour



- Ice scour dictates that all sea bed objects need to be buried (wellheads, manifolds, pipelines etc.)
- Soil conditions indicate that “glory holes” by themselves are not enough



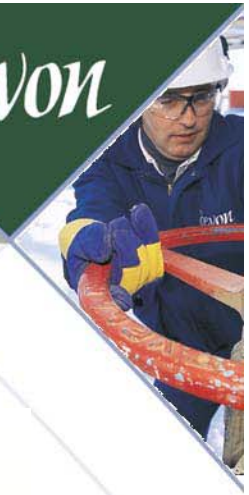
Note that depth values have been plotted at the mid point of the water depth range.

Core Elements

The core elements for a Beaufort Sea Development may include:

- A Central Production Platform (*CPP*)
- Sub sea Templates with Tie-backs to the *CPP*
- A Sales Pipeline

Core Elements:
Central Production Platform



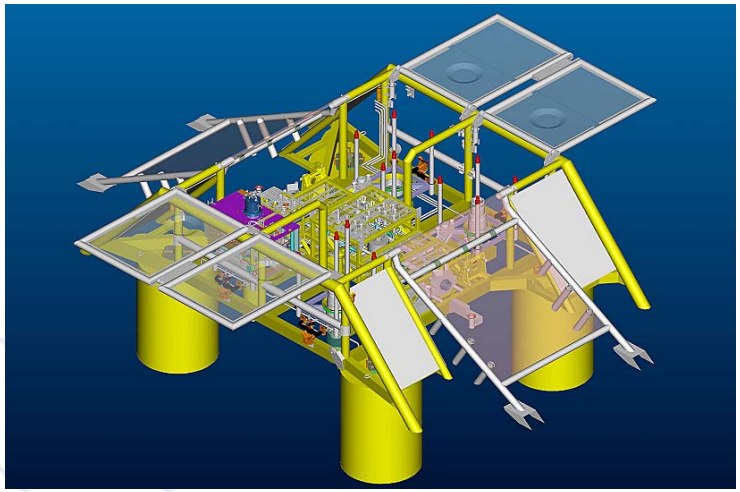
- Bottom founded structure
- Designed to resist:
  - Winter Ice Loads
  - Ice Collisions (1st year & multi-year Ice)
  - Wave Loads
- Provide for Production Facilities
- Provide logistical support for off-structure activities (development drilling, well maintenance etc.)

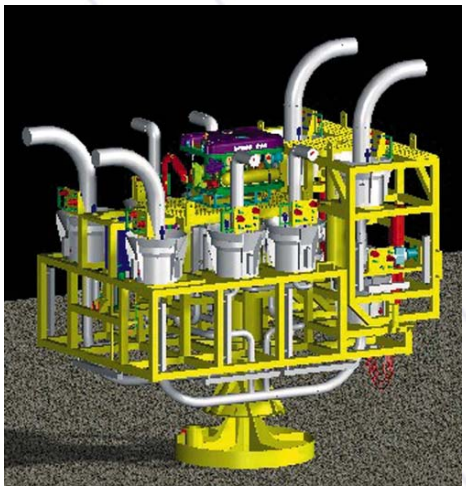
Core Elements:
Central Production Platform

NEW BUILD PRODUCTION PLATFORM ON LOCATION

Core Elements:
Remote Sub Sea Templates

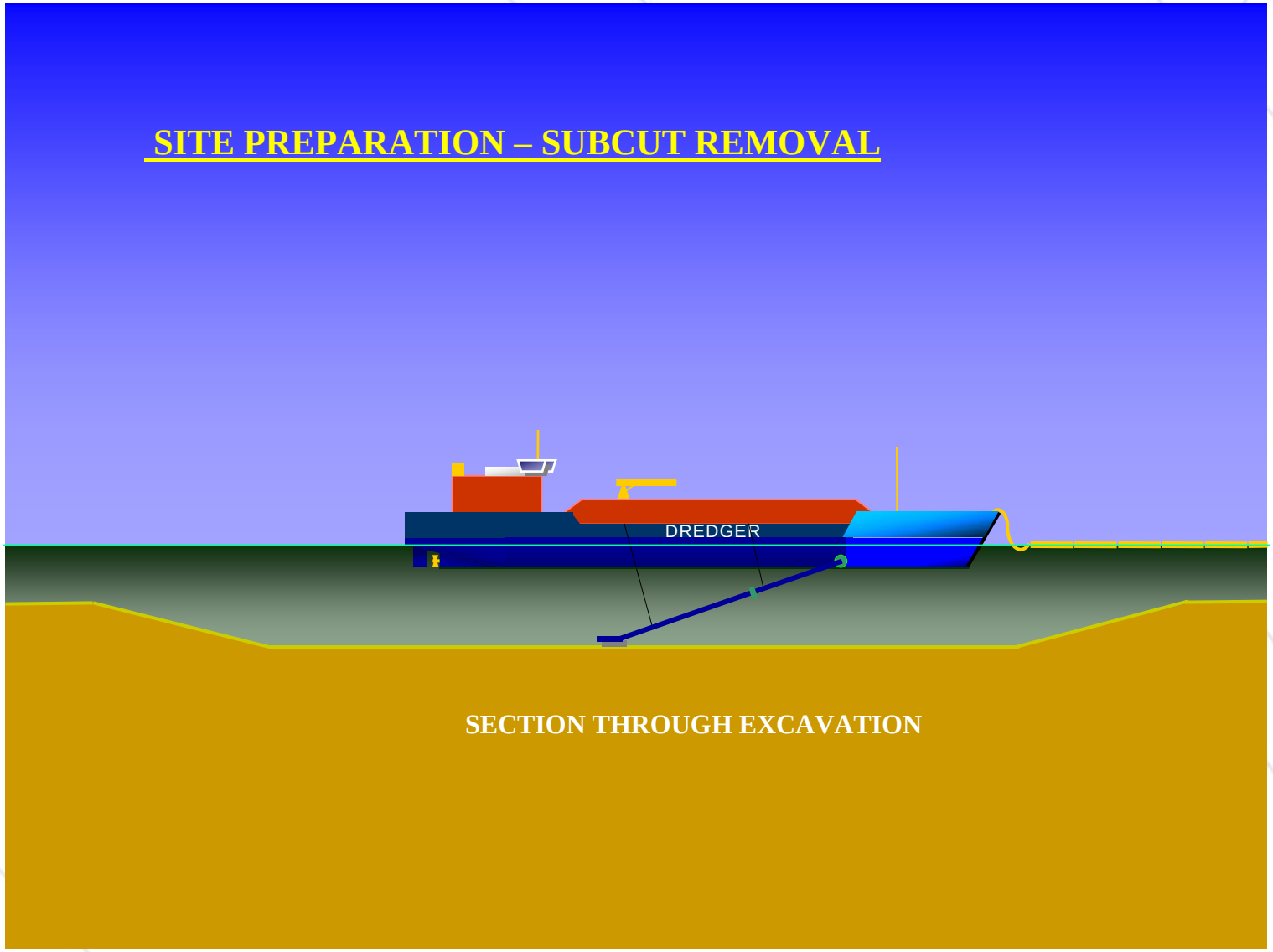
- Based on a sub sea multi-wellhead template per excavation
- Installed to withstand ice scours (plus stress zone)
- Silo design to protect wellhead template from ice scour
- Pipeline tie-backs to be installed using the latest jet dredging





Core Elements:
Remote Sub Sea Templates

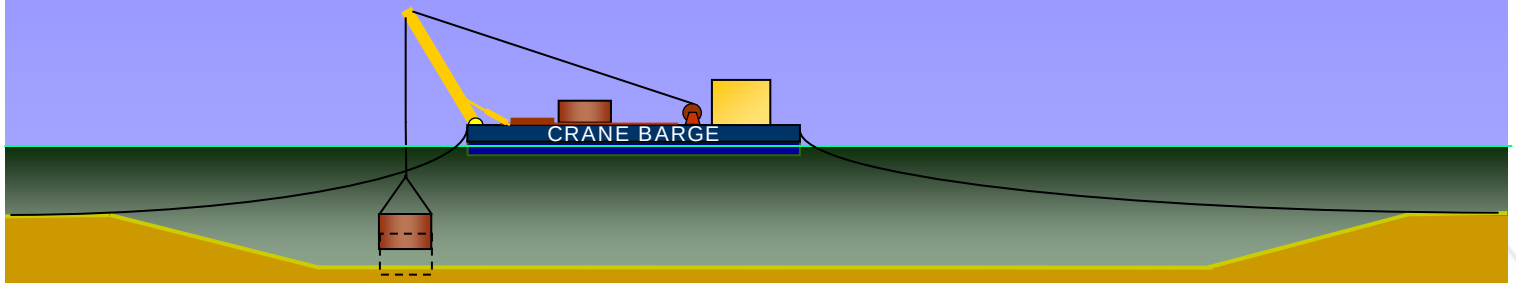
SITE PREPARATION – SUBCUT REMOVAL



SECTION THROUGH EXCAVATION

Core Elements:
Remote Sub Sea Templates

SITE PREPARATION – WELLHEAD CAISSON INSTALLATION



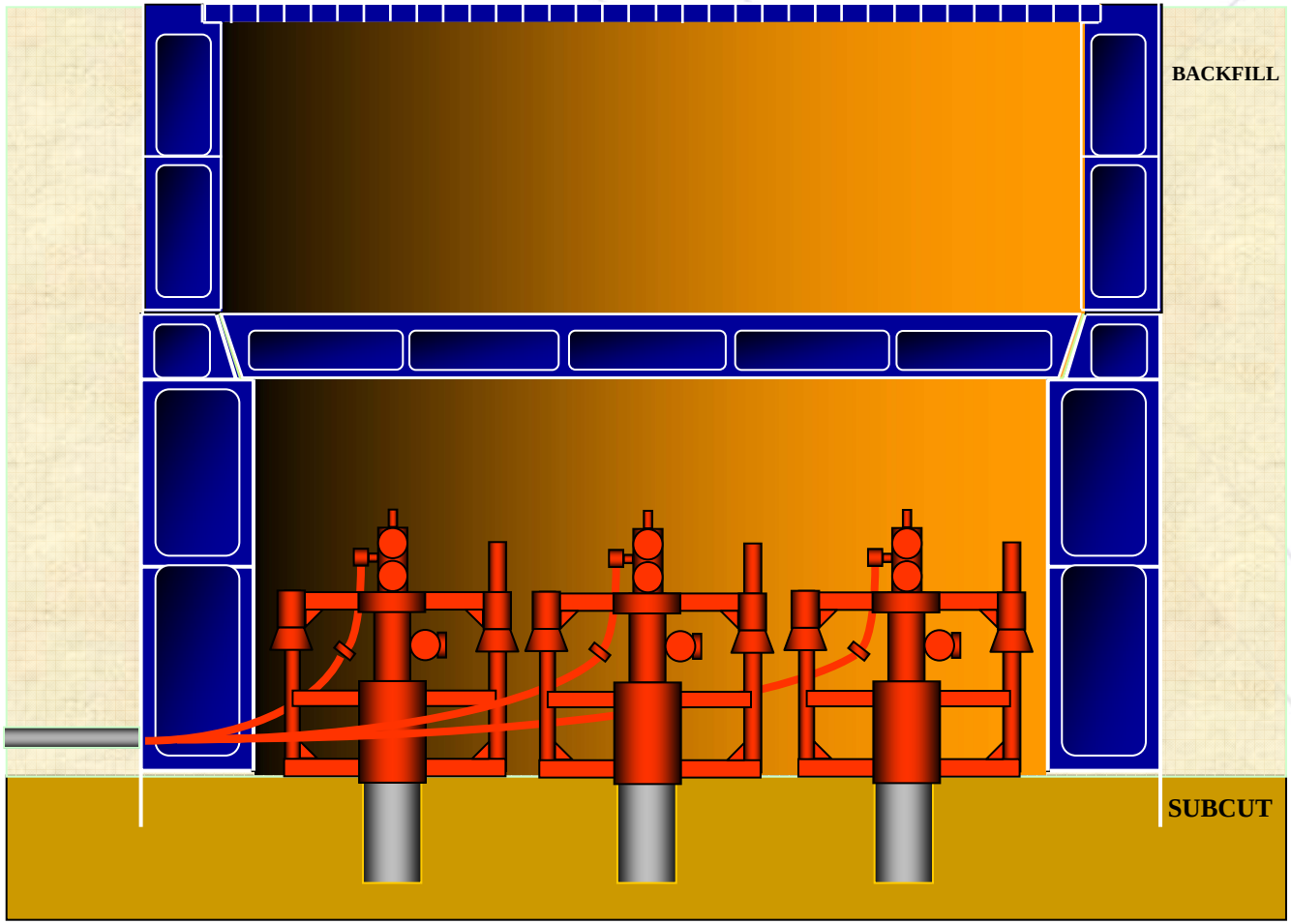
SECTION THROUGH EXCAVATION

Core Elements:
Remote Sub Sea Templates

SITE PREPARATION – BACK-FILL LEVELING

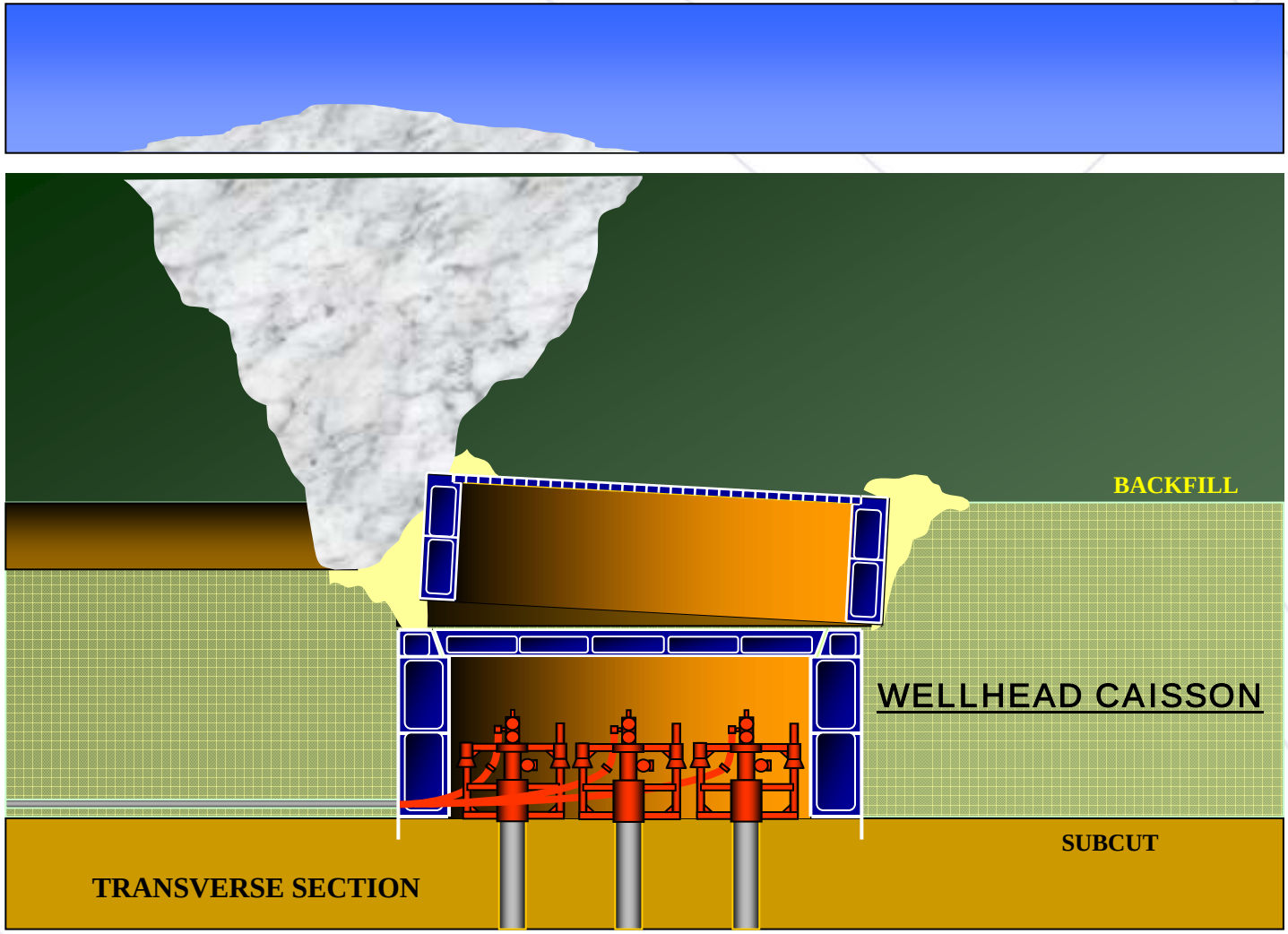
SECTION THROUGH EXCAVATION

Core Elements:
Template Silo Design



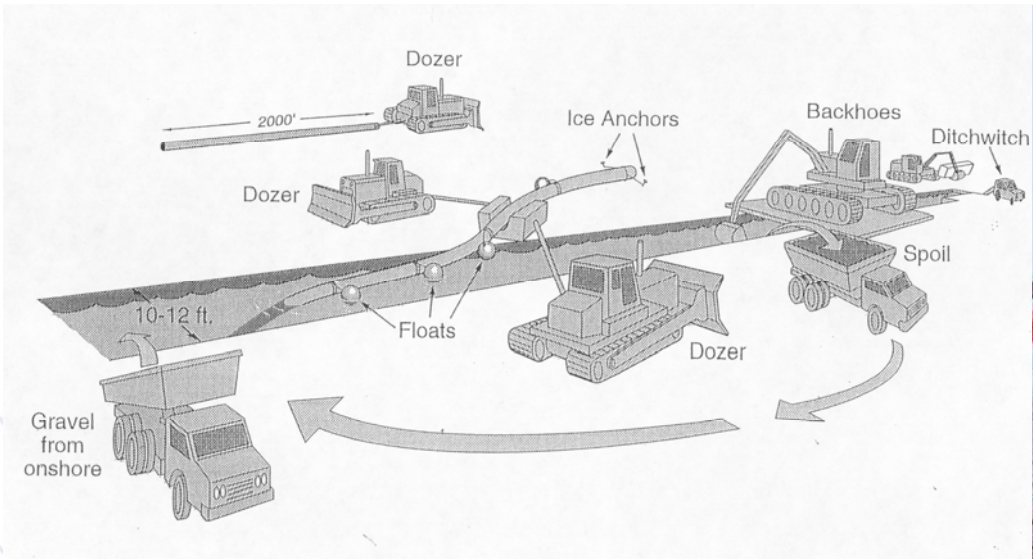
TRANSVERSE SECTION

Core Elements:
Template Silo Design

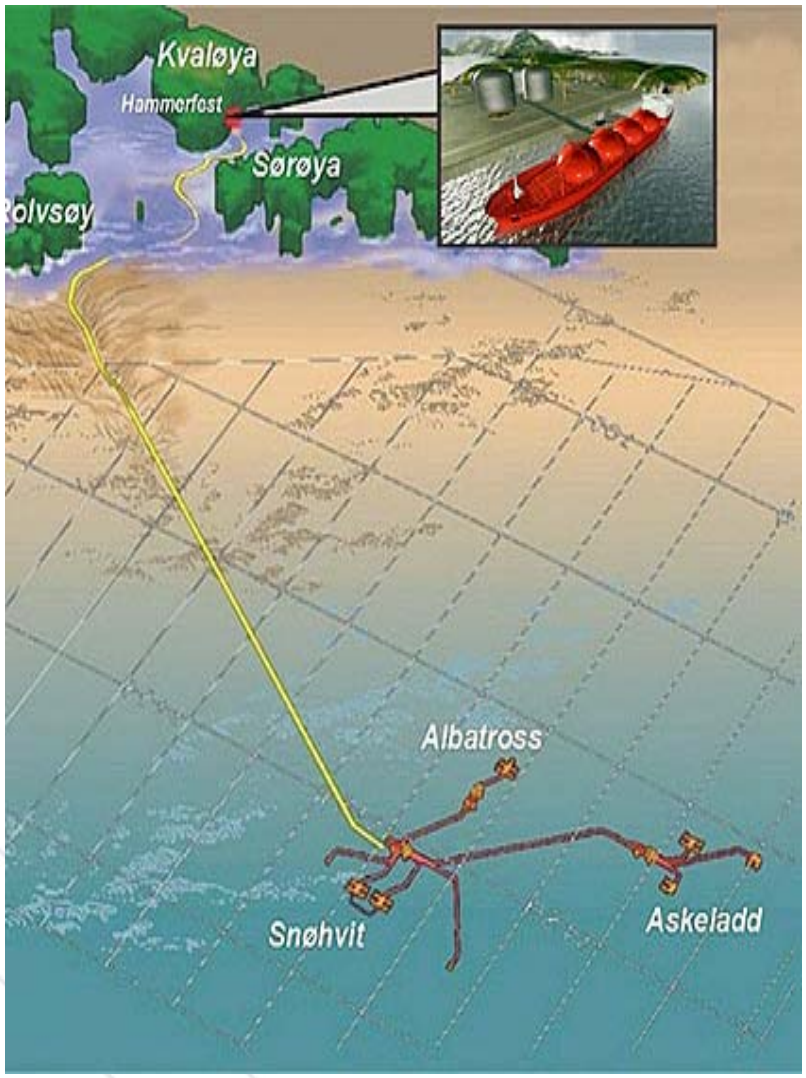


Core Elements: Pipeline

- The pipeline is required to transport gas from the CPP to onshore
- The offshore pipeline may be installed in two phases:
  - > 4m Water Depth which will be jetted-in below scour depth
  - < 4m Water Depth which will be trenched-in through the ice
- The aspects of heat transfer (permafrost) & hydrate formation need to be carefully considered



Development Concepts



- The Canadian Beaufort provides a unique and sensitive environment for oil & gas development
- Existing development technologies need to be adapted and new technologies created
- Significant infrastructure needs to be built to support a development
- The technologies of remote sub sea equipment need to be adapted to fit protective silos
- A Beaufort development would benefit from sub sea processing, separation, injection, potentially eliminating the need for an offshore Central Production Platform
- The challenges of an offshore development would make those of exploration drilling seem insignificant!

Potential Beaufort Development ....