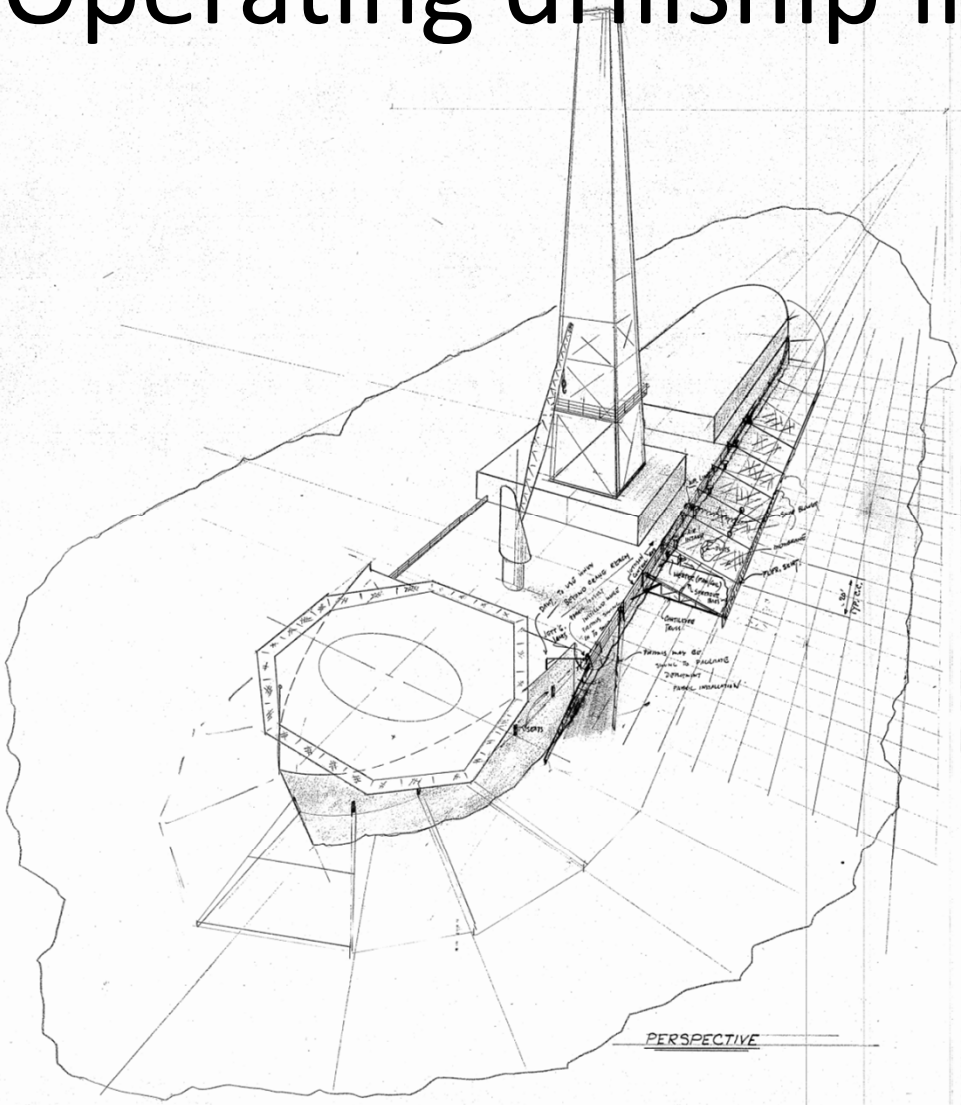
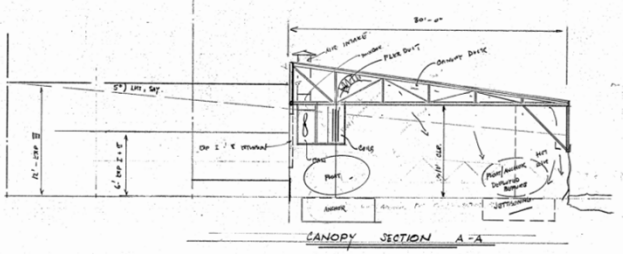
Concepts Considered by Dome Petroleum in 1980s

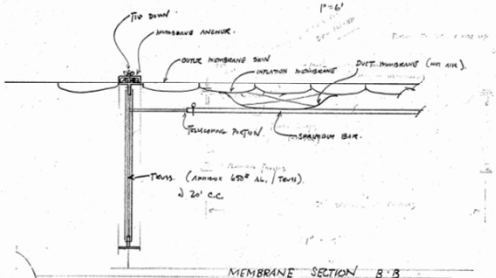
Part 2, March 19, 2014

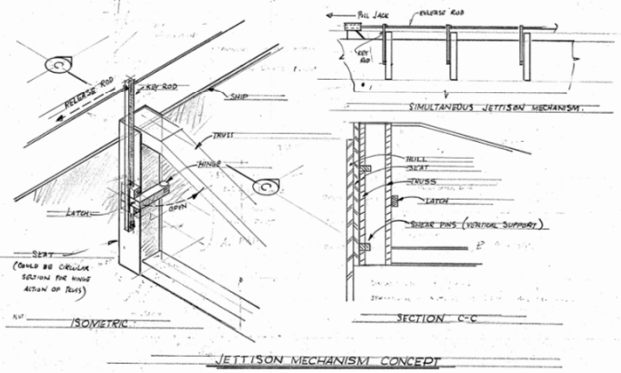
Presented by Roger Pilkington

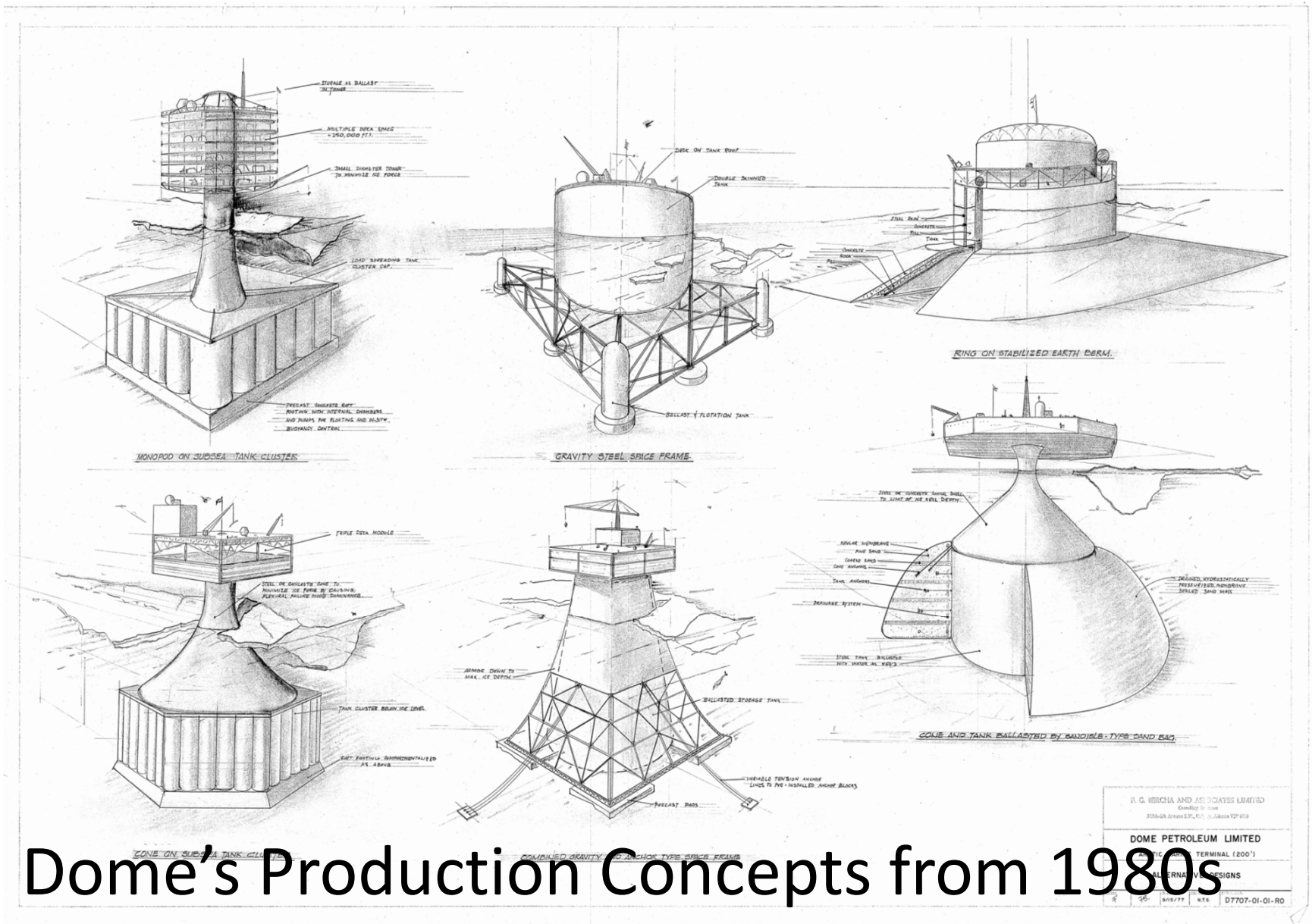
Operating drillship in landfast ice







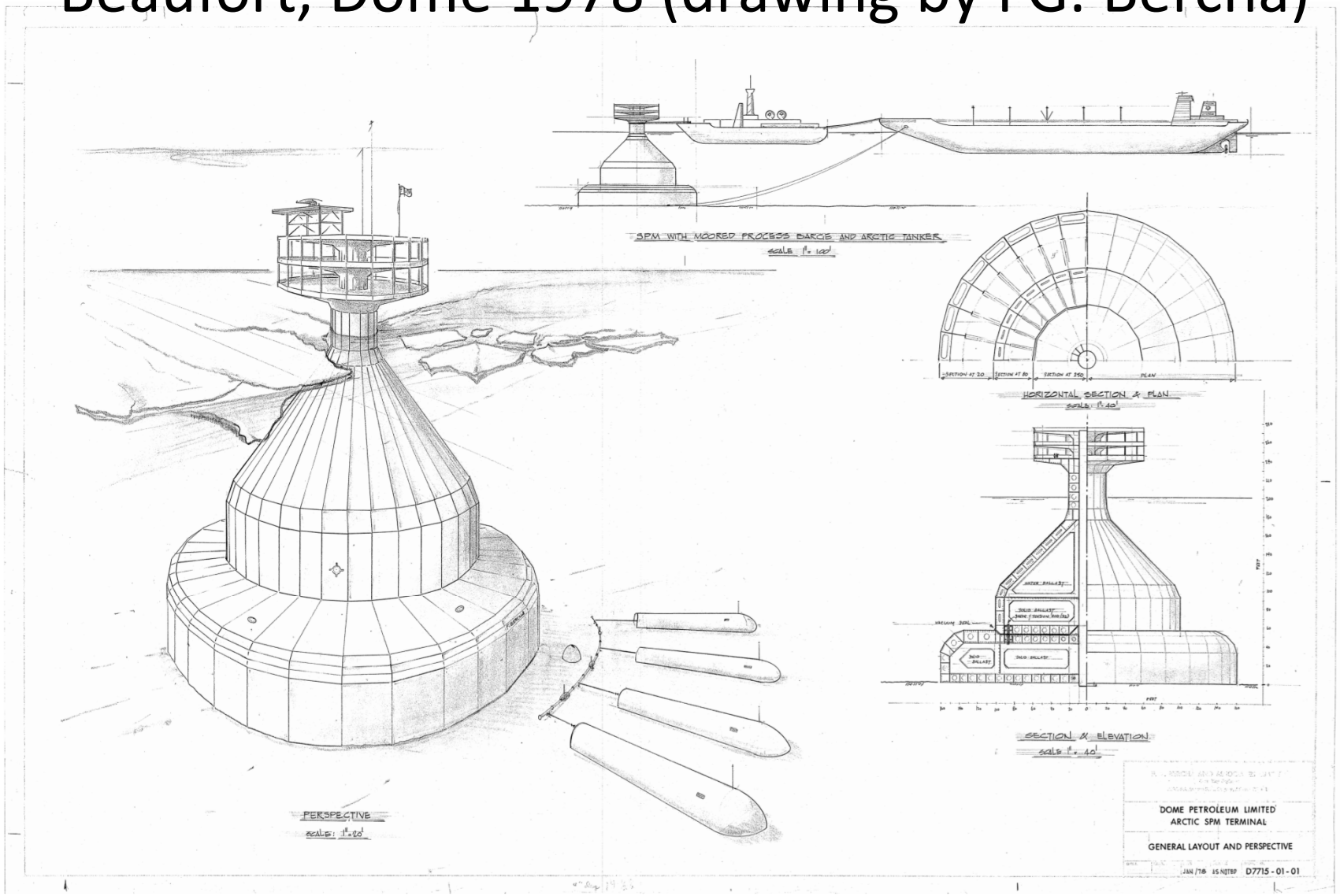


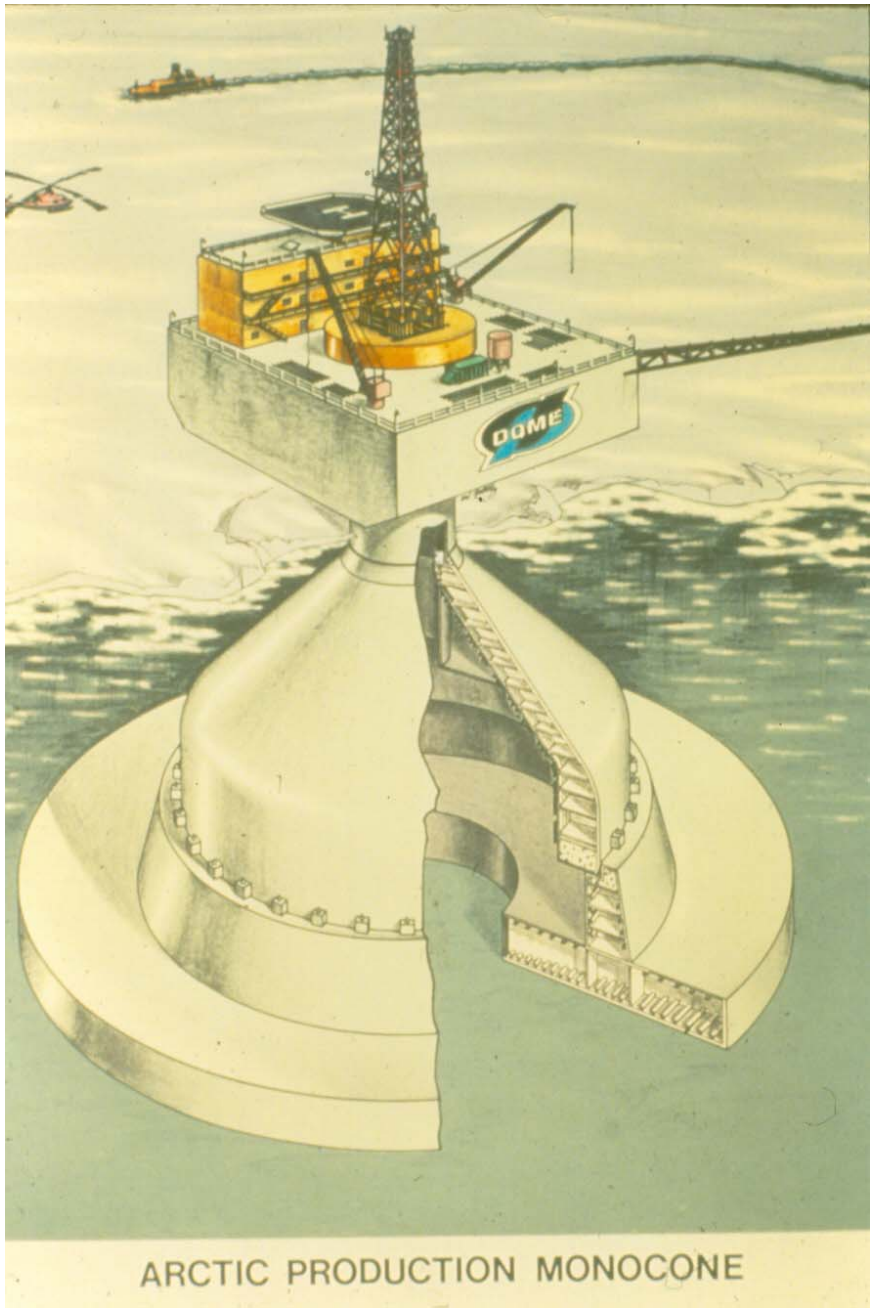


Dome's Production Concepts from 1980s

(from FG Bercha)

Mono-Cone Production Structure proposed for Beaufort, Dome 1978 (drawing by FG. Bercha)



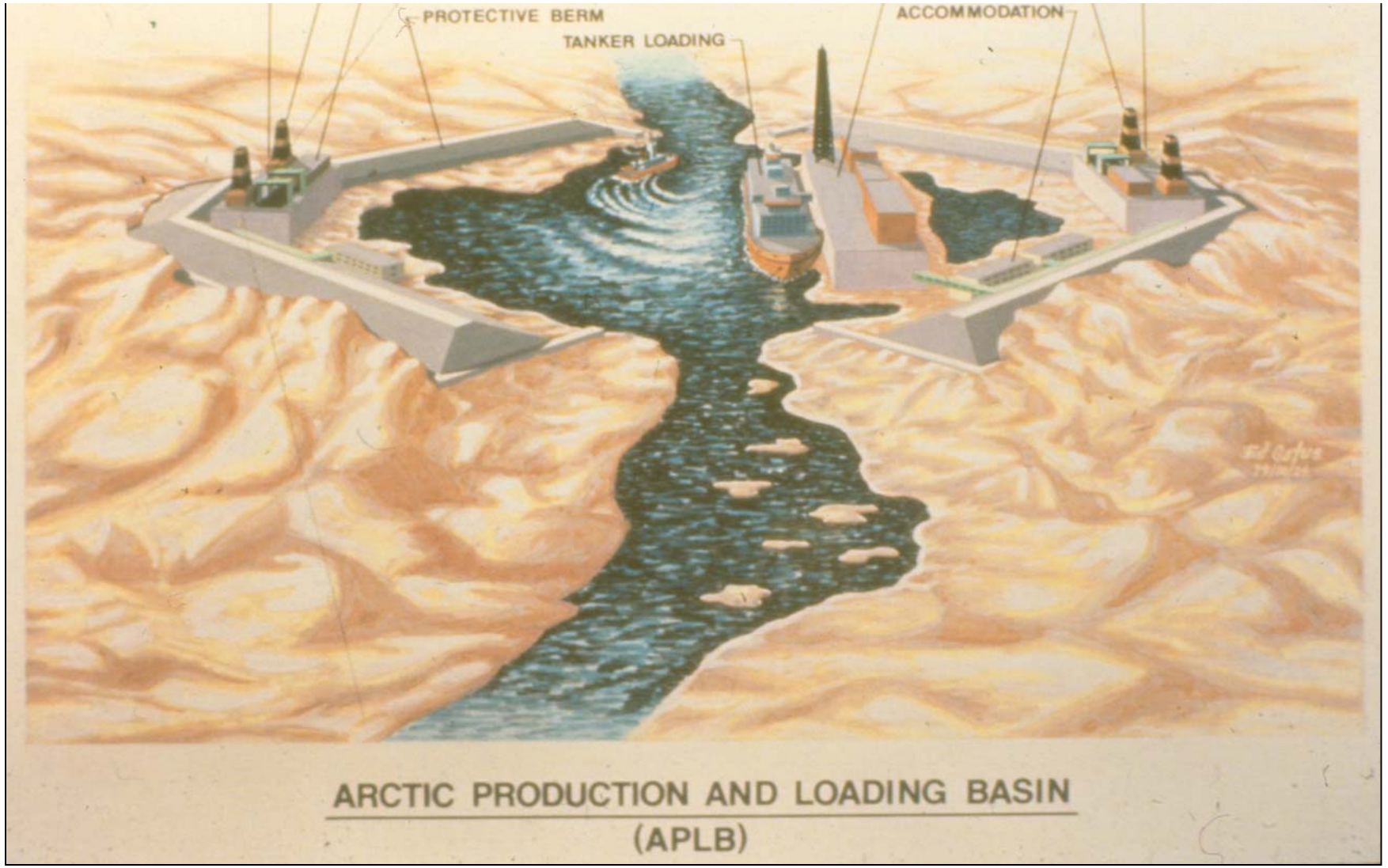


Arctic Production Monocone

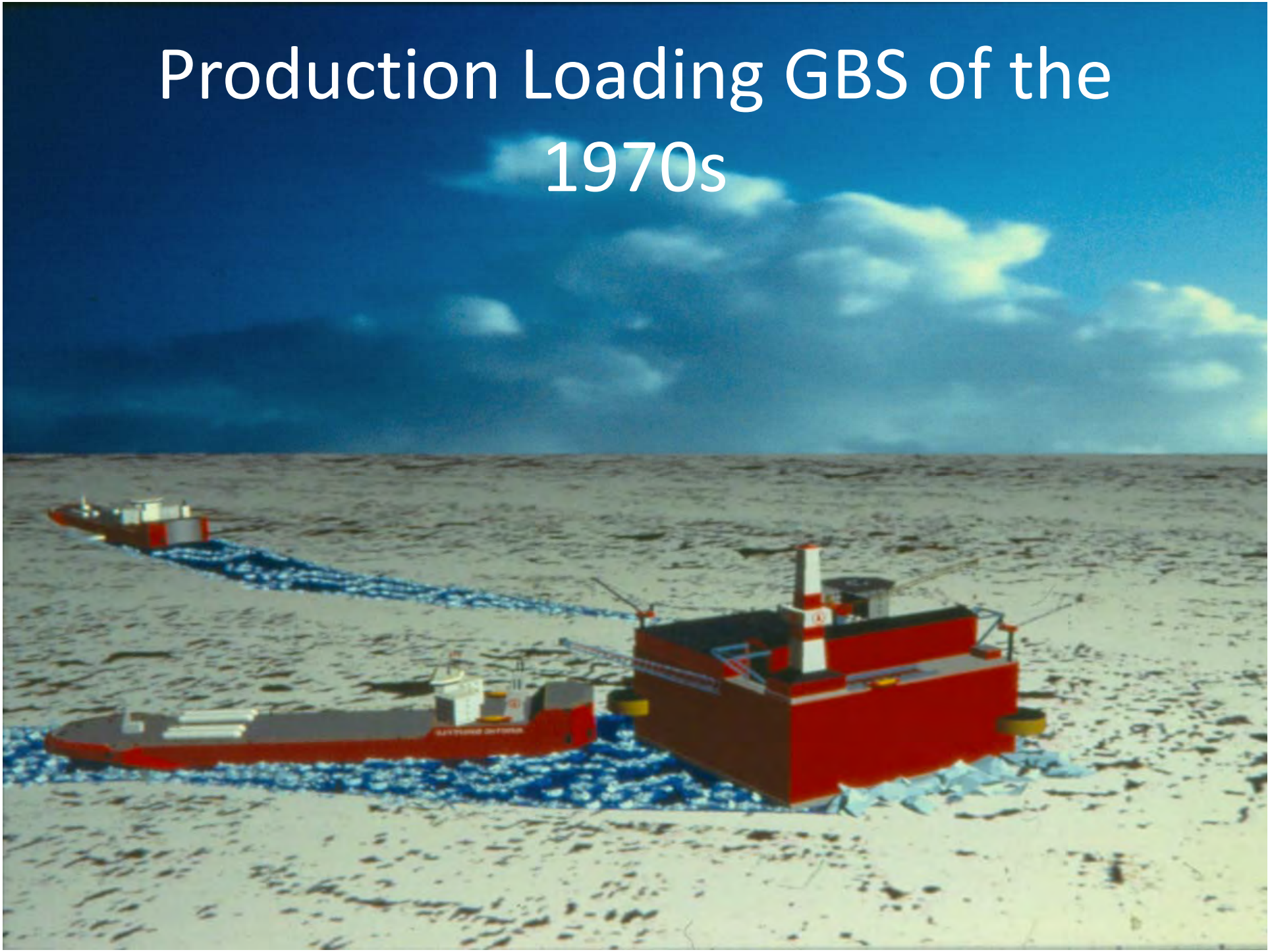
Designed to be disconnected

(drawing by FG Bercha)

Loading Structure Proposed by Dome Pet. for Production in Beaufort Sea



Production Loading GBS of the 1970s



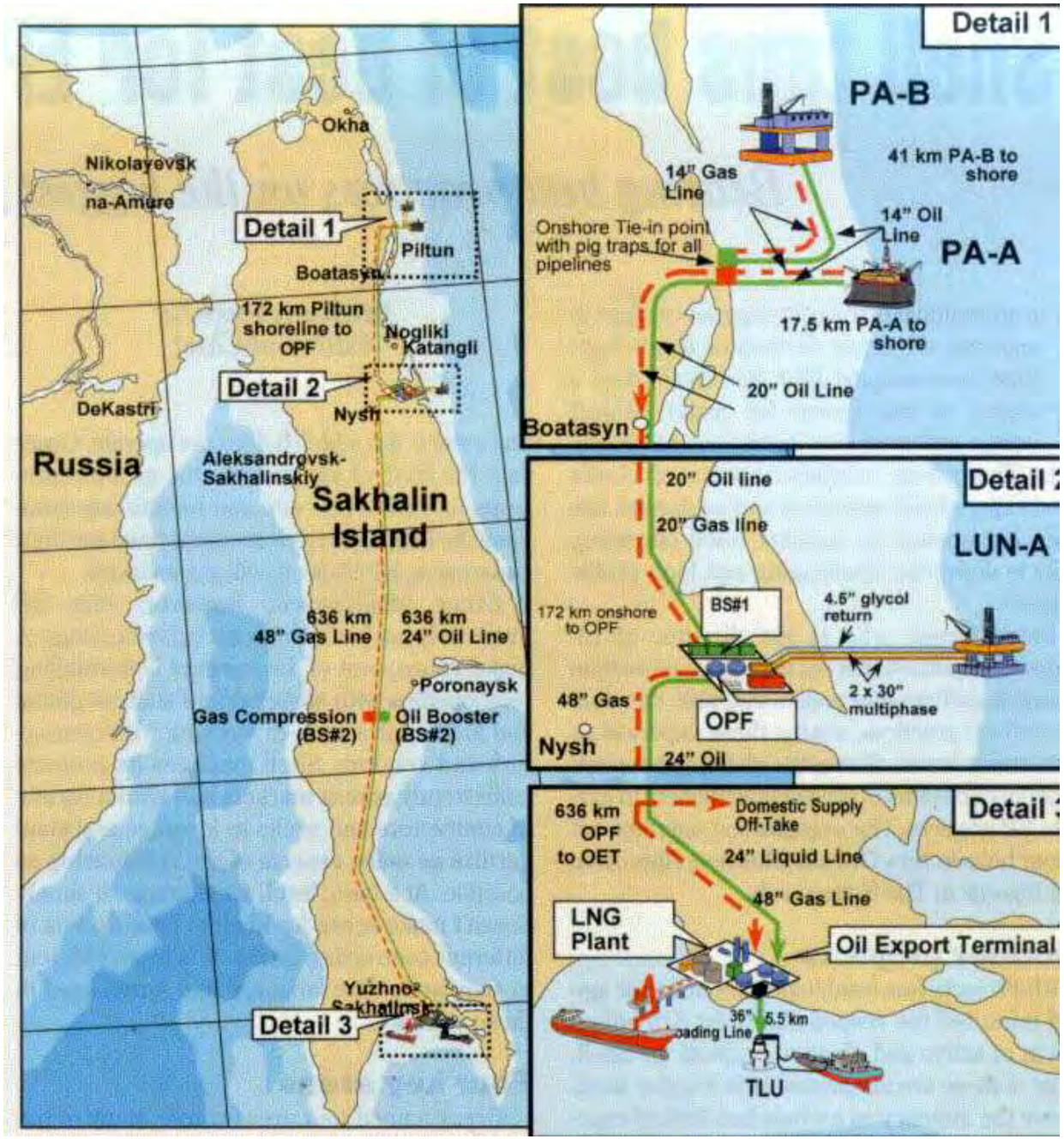
Operating Production Systems

Molikpaq at Sakhalin Island

Sakhalin Energy Investment Corporation

Early production using SALM, FSO and offloading tanker

Sakhalin II Piltun-Astokhskoye-B (PA-B) GBS, Sakhalin Energy



Sakhalin Development

Sakhalin Energy

CIDS – Exxon Neftegaz Production structure at Orlan off Sakhalin Island


Hibernia
Icebergs very
little pack ice

White Rose and Terra Nova FPSOs used on Grand Banks. (Husky & Petro-Canada)

- Icebergs but little pack ice

Prirazlomnaya platform
Pechora Sea. Gasprom

Verandey
Tanker loading structure.
Pechora Sea

Lukoil-ConocoPhillips

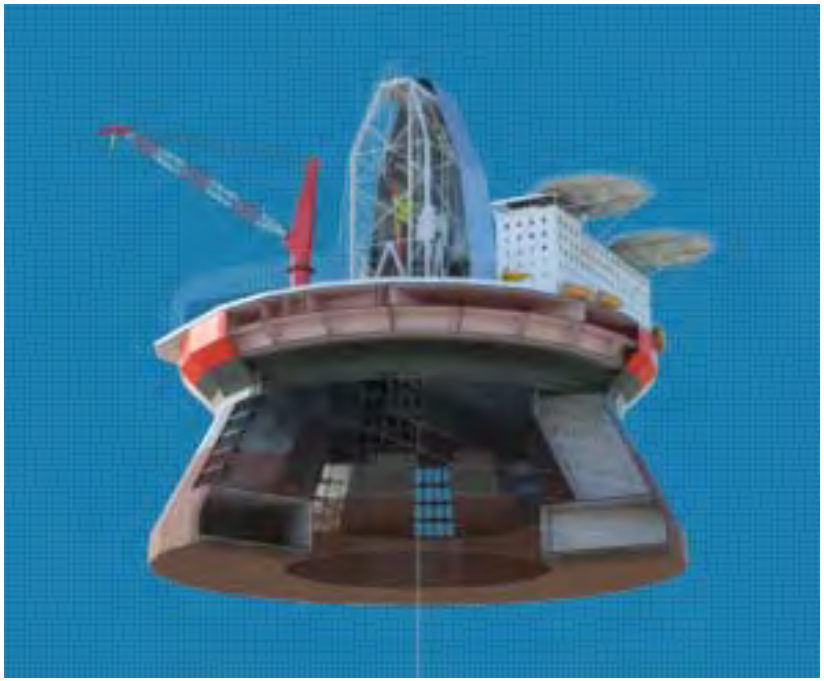
Sakhalin-1 De-Kastri Terminal in Khabarovsk Krai,
West of Sakhalin Island, Russia.
Single Point Mooring facility (SPM) loads tankers year round. Exxon Neftegas Ltd

Bay of Bohai structure

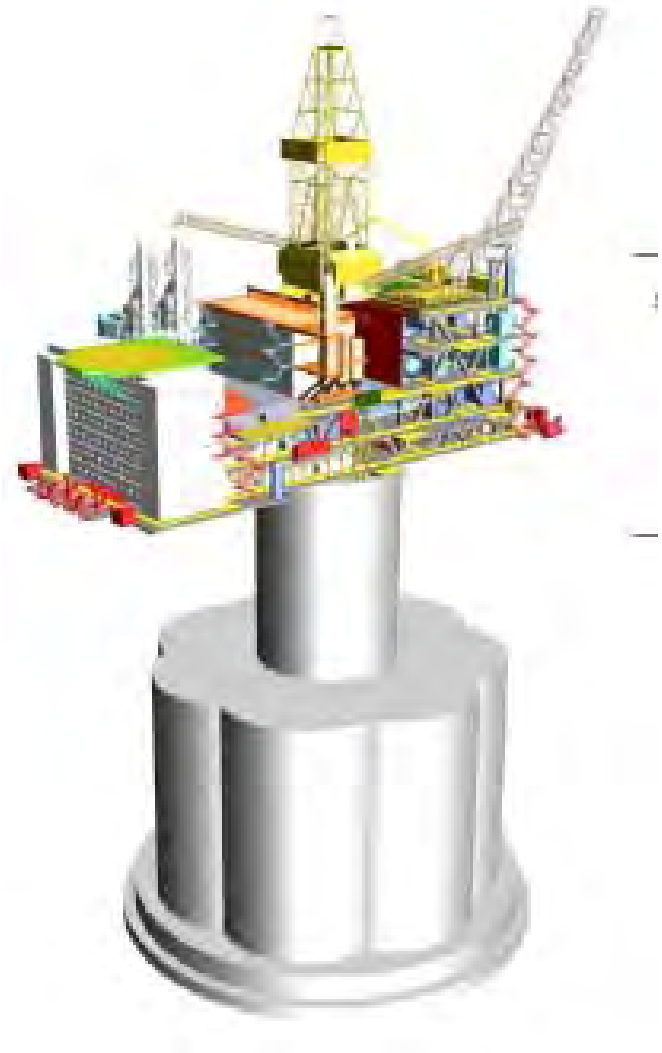

Stena DrillMAX Ice

Recent Concepts for Production Systems in Arctic Waters

Huisman JBF Arctic operates in open water (semi-sub), in ice (Kulluk like) and as GBS

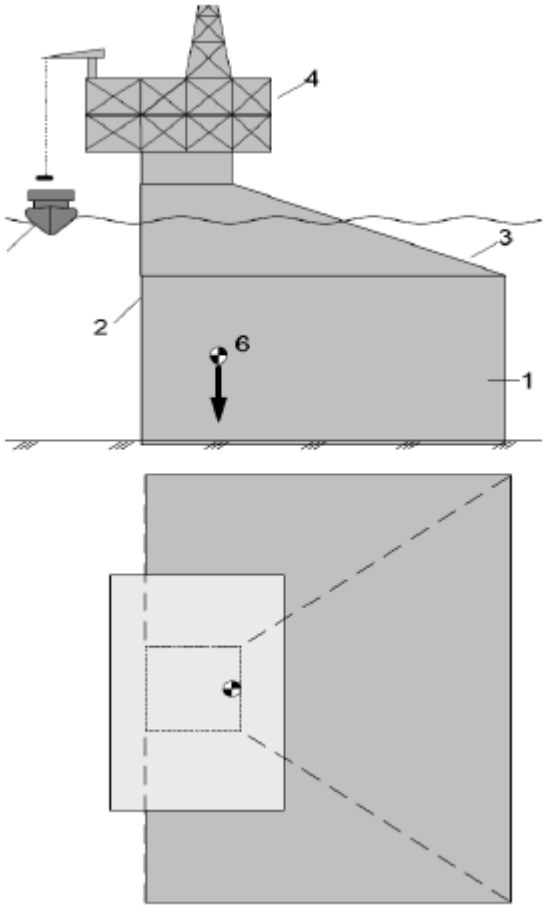


ExxonMobil Hebron GBS

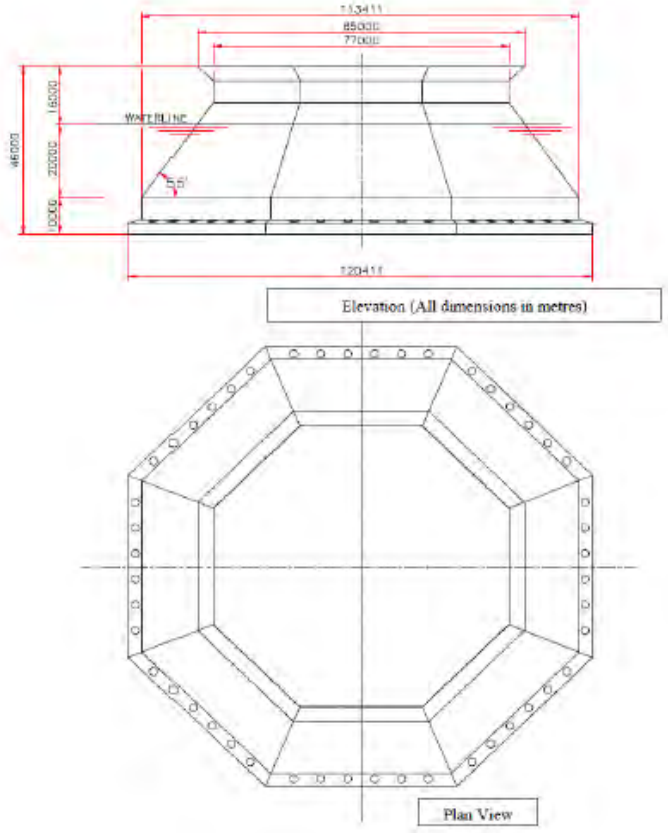


Designed to withstand sea ice, icebergs, and wave conditions

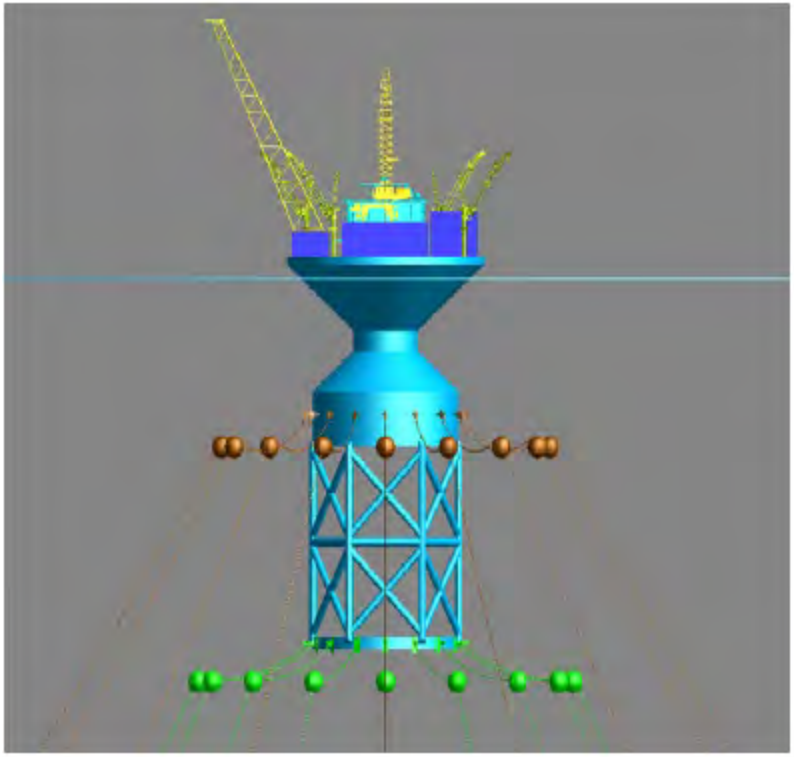
Exxon Half-cone GBS

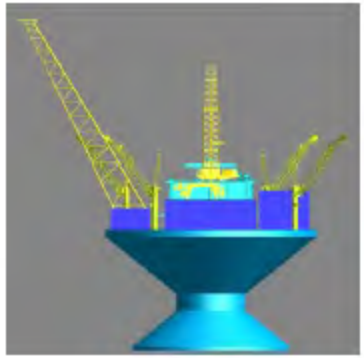


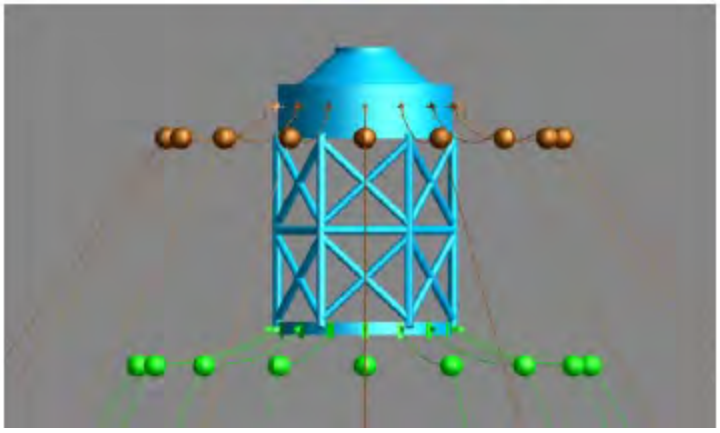
ConocoPhillips GBS



ConocoPhillips Deep Arctic Floater





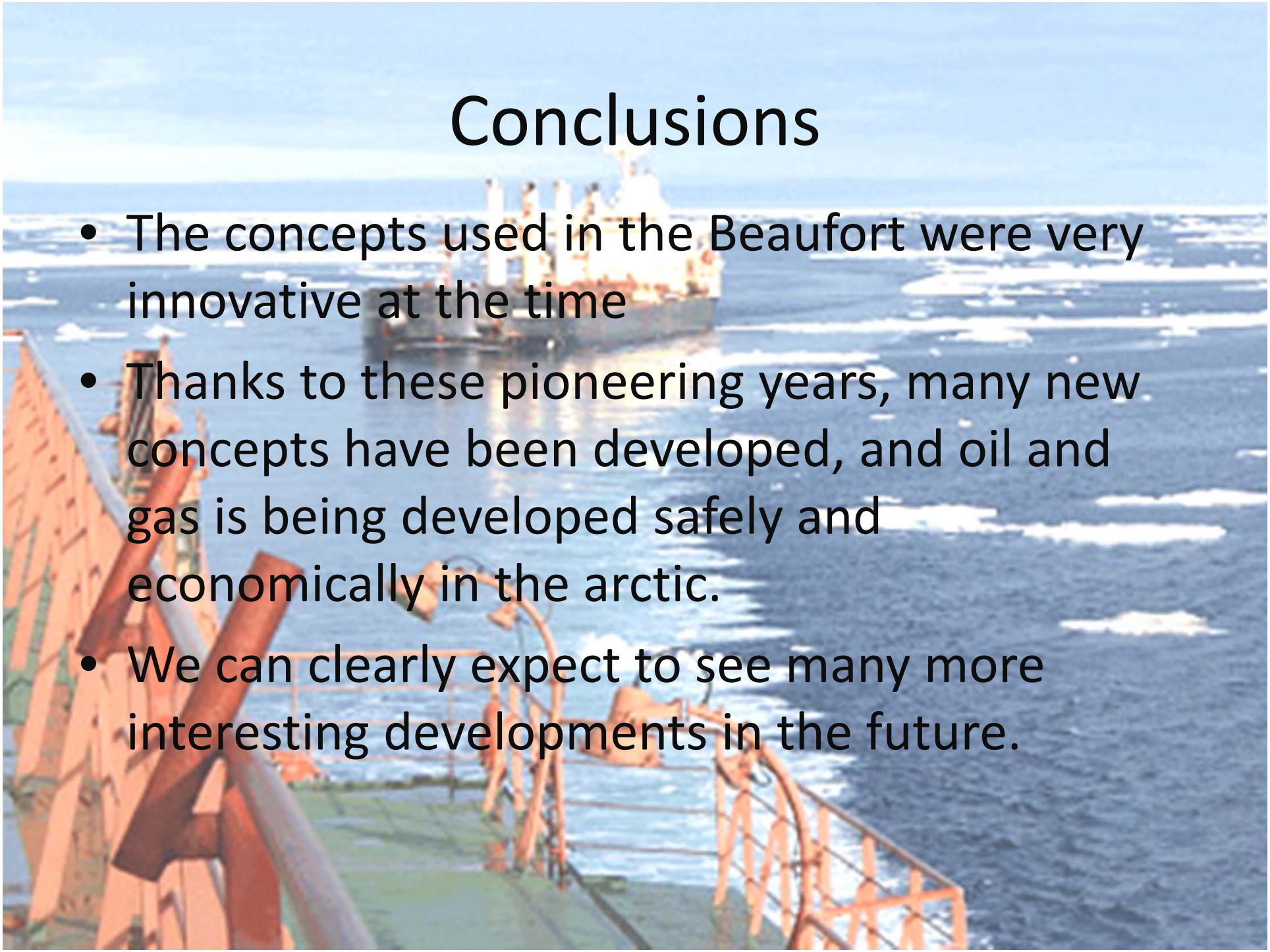


GustoNSC Nanu Q 5000

Inocean IN-ICE Drillship

Platform-free oil in Arctic waters within striking distance
By Balazs Koranyi, Reuters | January 7, 2013

- “By the time the real Arctic fields in the ice-infested waters of Alaska and Siberia are ready for development, the technology will be there for platform-free production,” says Tore Halvorsen, the subsea chief of FMC Technologies.
- “The game changer is to have fluid extracted, processed and directly exported from the field without intervention from a platform… We’re not far from that.”



Conclusions

- The concepts used in the Beaufort were very innovative at the time
- Thanks to these pioneering years, many new concepts have been developed, and oil and gas is being developed safely and economically in the arctic.
- We can clearly expect to see many more interesting developments in the future.

Table 5 Details of the Molikpaq deployment in the Beaufort Sea.

Site	Year Deployed	Water Depth (m)	Setdown Depth (m)	Subcut Depth Below Seabed (m)	Berm Height Above Seabed (m)	Core Height Above MSL (m)	Fill Quantity (m^3)
Tarsiut P-45	1984	25.5	19.5	3.5	6.0	2.0	450,000
Amauligak I-65	1985	31.0	19.5	9.0	11.5	1.5	1,400,000
Amauligak F-24	1987	32.0	15.8	16.0	16.2	4.8	2,200,000
Isserk I-15	1989	11.7	13.4	1.7	N/A	-3.8	70,000

Some of Field Projects conducted in 1970s to 90s

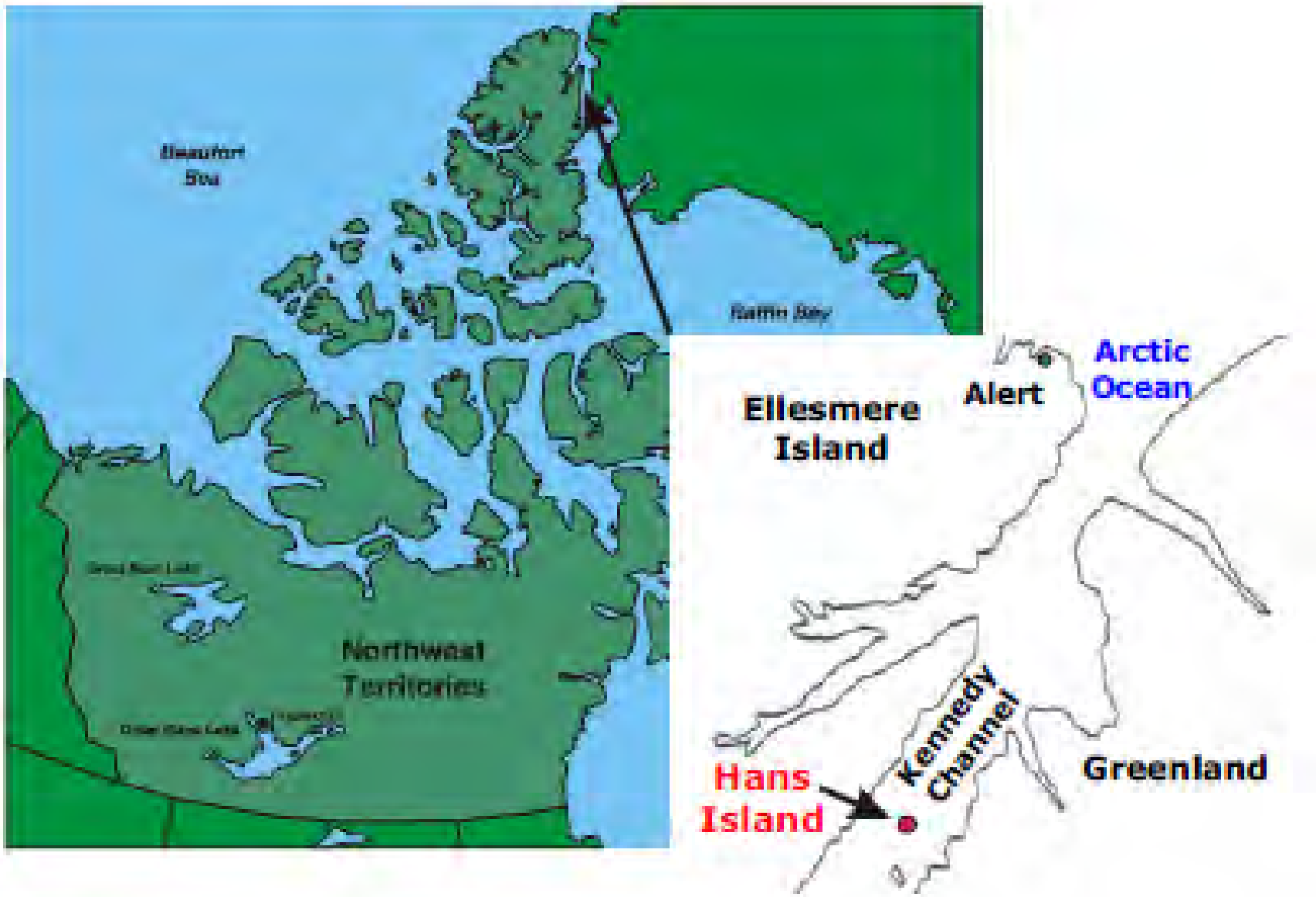
Name of Project	Year conducted	Purpose
Esso Ice Test Basin	1970s	Ken Croasdale and others conducted small to medium size ice impact tests in Esso's ice basin on 58th Ave and 4th St SE, Calgary
Arctic Joint Ice Dynamics Project (AIDJEX)	1972	Study of ice, atmosphere and ocean interaction. Large camp on ice for many years. Mainly U of Washington
IB Kigoriak test program	1979	Test icebreaker in pack ice in winter. Believed to be first ice breaker to venture into shear zone in Beaufort in winter
Beaufort Field Tests	1970 to 90	Large number of field tests to investigate ice thickness, drift speed, land fast ice movement, MY and FY ridge heights and numbers, extreme ice features, ice islands, ice strength, etc
Tarsuit Island Research Projet	1982/83	Profile rubble field, measure in-ice pressures and ice movements
Bryam Martin Indentation Tests	1984	Indentation tests carried out to measure strength of MY ridge ice. Indenter areas up to 2.5m^2.
Hans Island	1980 and 1981	Ice floe impact against a small island in Kennedy Channel to get full scale ice pressures for ice impact on structures. See slides below.
Pack Ice Driving Force Projects	1986, 89, 91	Field projects to measure peak pack ice forces associated with ridge building.
Exxon Large Beam Strength Tests	Winter 1979/80	13 large scale ice strength tests were conducted offshore Prudhoe Bay, to determine uni-axial compressive strength of ice.

Arctic R & D Organizations since 1970s

Organisation	# Reports	Types of Studies
Esso, Dome, Gulf, Sun, Arco, Exxon, Shell, etc	Dozens	A lot of R&D was done by oil companies themselves. All had large research departments and carried out projects relevant to their own needs.
APOA	222	Formed in 1970 to conduct joint industry studies of common interest. Ended in 1985. Most or all studies are in AINA at U of C.
AOGA	Hundreds	Similar to APOA but for Alaska. Still operational
Environmental Studies Research Funds (ESRF)	162	Started 1983. Funded by oil companies from levies on frontier lands. Covers Environmental and Social Studies. Reports free -NEB.
Program of Energy Research and Development (PERD)	Hundreds	Federal Interdepartmental program operated by NRCan. Started in 1972 - ongoing. In 2009, funding $55 million per year; but only portion is Beaufort related. Most reports are public and on web.
Beaufort Environmental Impact Statement (EIS)	7 vols	Dome, Esso, and Gulf prepared the EIS in 1982 for potential oil and gas production in the Beaufort. Reviewed plans and considered impacts.
NRC Snow and Ice Subcommittee	11	Started in 1953 and lasted to 1988. Sponsored workshops on a range of topics.
R&D Review Reports	5	Reports written in the 1990s to 2005 to identify critical research issues for offshore development in the Beaufort Sea.

The shuttle tanker Kometik transports oil from the Hibernia platform to the Transshipment Terminal at Whiffen Head.

Location of Hans Island



MY Floe Hitting Hans Island

Where are they now?

- Sand and gravel islands eroded to halocline (-10m)
- Dome drillships 1-3 probably scrapped. Exp 4 in use
- Gulf Kulluk purchased by Shell. Being scrapped
- Gulf Molikpaq converted to production structure in Far East Russia (Gazprom/Shell)
- Tarsiut caissons in Arctic and available for $1 (negotiable)
- Esso CRI? I think still in Tuk harbour
- Dome SSDC available for lease in Arctic
- Global Marine CIDS is now production platform in FER for Exxon Neftigaz (Orlan)