NCOC
NORTH CASPIAN
OPERATING COMPANY

NORTH CASPIAN SEA PROJECT

NCOC
NORTH CASPIAN OPERATING COMPANY

ONE OF THE LARGEST AND MOST COMPLEX PROJECTS IN THE WORLD

RECOVERABLE OIL

9-13 billion barrels
(1-2 billion tons)

North Caspian Operating Company N.V. (NCOC) acts as Operator on behalf of the Consortium of seven oil&gas companies: KazMunayGas, Eni, Shell, ExxonMobil, TotalEnergies, CNPC and INPEX.

Each shareholder is individually responsible for transportation and sales of its share of production according to NCSPSA.

KASHAGAN DEVELOPMENT: THE CHALLENGE IS ACCEPTED

NCOC
NORTH CASPIAN OPERATING COMPANY

PRESSURE

High pressure
800 bar

H_2S

High concentration of
H_2S (15% - 23%)
CO_2 (4% - 8%)

WEATHER

Extreme weather conditions
-40°C/+40°C

SHALLOW WATERS

Shallow waters of only
2 to 4 m

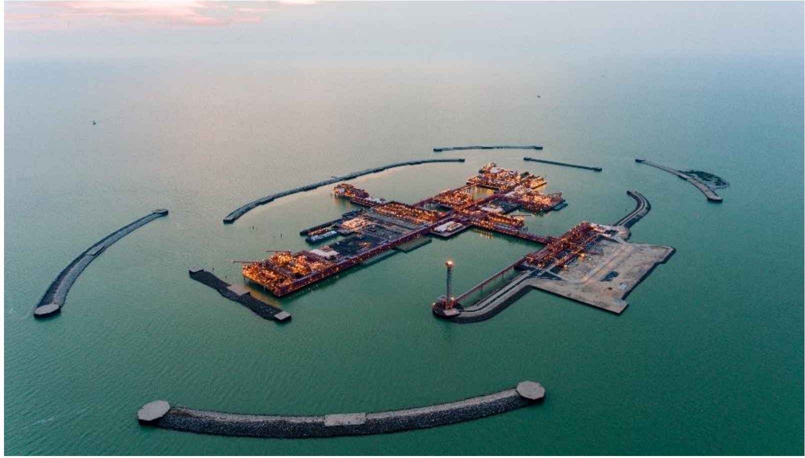
ICE MOVEMENT

ICE MOVEMENT
and formation of hummocks

ENVIRONMENT

Sensitive
ENVIRONMENT

NORTH CASPIAN PROJECT MILESTONES



1993

Agreement on establishment of the Consortium for studies in Kazakhstan sector of the Caspian Sea

2D Seismic works in the Caspian Sea start

North Caspian Sea PSA signed

Drilling of the first exploration well – Kashagan East-1

2000

Discovery of hydrocarbons in the first Exploration well

D Island construction starts

Construction of Onshore Processing Facility starts

Start-up of Kashagan Production Facilities

2016

Production re-start. First batch of crude oil dispatched for export

NCOC reaches actual production Levels of over 200,000 BPD

2018

NCOC reaches actual levels of 43 thousand t/d (343,000 kbbl/d) and produces a total of 22.5 million tonnes of stabilized oil from Kashagan

2019

NCOC successfully completed the first turnaround of its onshore and offshore facilities

2021

NCOC reached significant milestone – 500 million barrels of oil since Kashagan restart in 2016

SAFE AND STEADY PRODUCTION SINCE 2016

	CUMULATIVE since Sep 2016	2022 YTD (as of December 31, 2022)
OIL EXPORT	**80.7 million tons**	**12.7 million tons**
GAS EXPORT	**48.4 billion sm^3**	**7,878.3 billion sm^3**
SULFUR EXPORT	**7,618 thousand tons**	**984 thousand tons**

LOCAL CONTENT IN PROCURED GOODS, WORKS & SERVICES

NCOC
NORTH CASPIAN OPERATING COMPANY

2004-2022

16.6

BILLION US$

2022

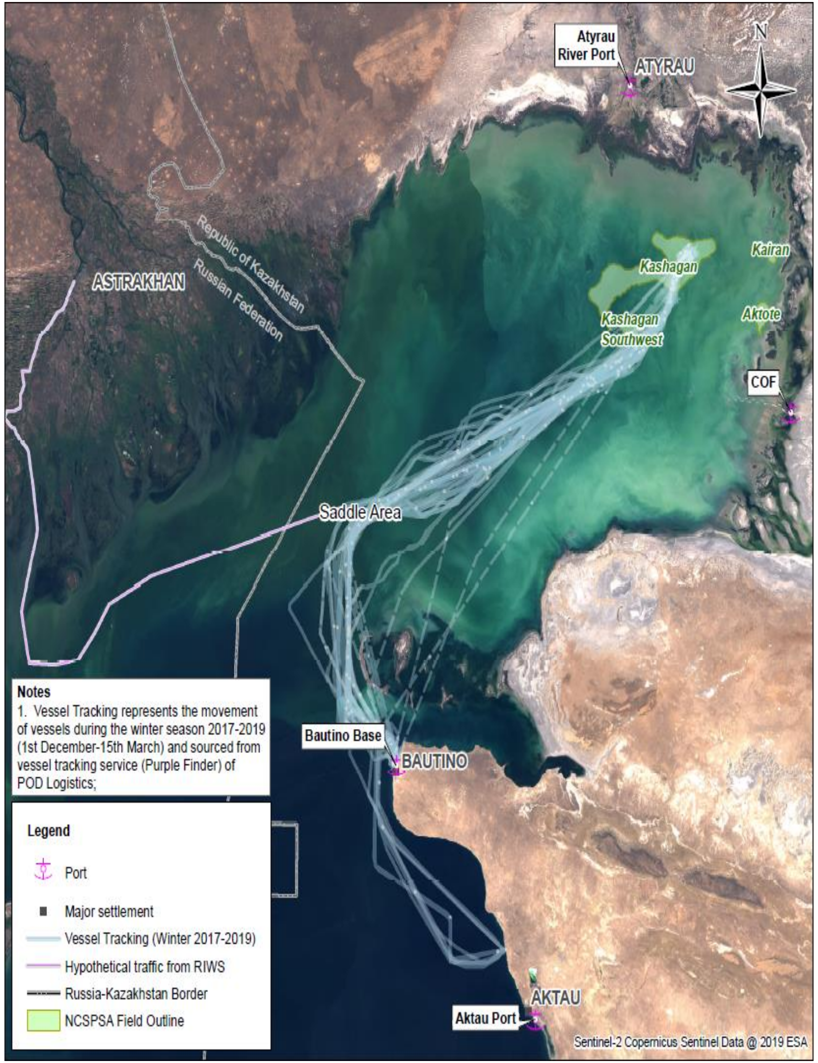
$748 / 59.4

MILLION US$ %

NCOC
NORTH CASPIAN OPERATING COMPANY

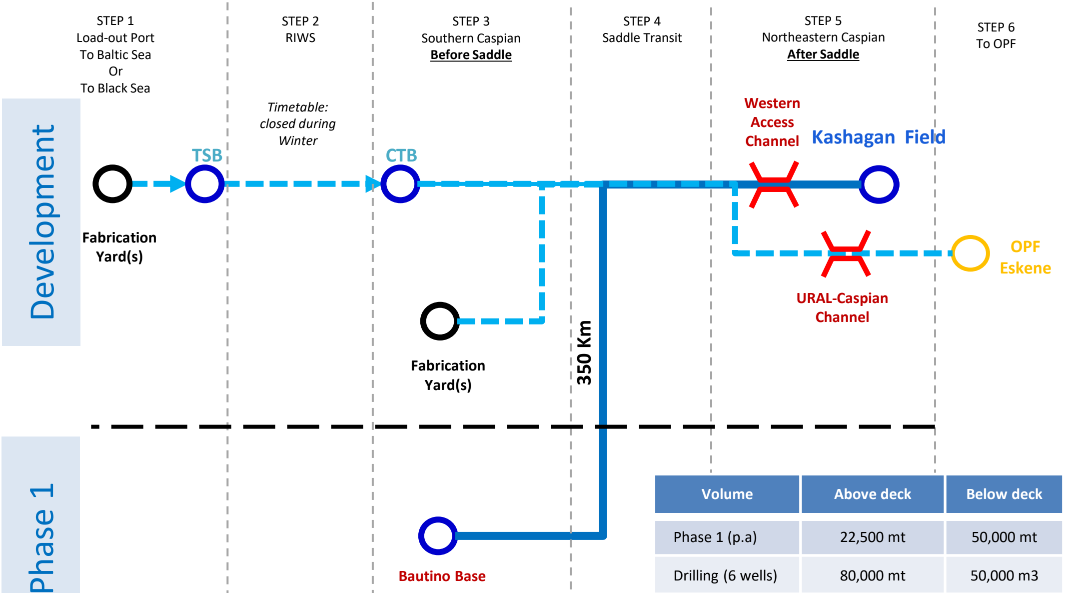
OFFSHORE SUPPLY CHAIN

MARINE ROUTES



Marine transportation Routes

Development Project
Phase 1
Navigation limitation



Volume	Above deck	Below deck
Phase 1 (p.a)	22,500 mt	50,000 mt
Drilling (6 wells)	80,000 mt	50,000 m3
Growth	42,000 mt – 147,000 mt	711,200 m3

Indicative values

TSB: Transition Storage Base (buffer)
CTB: Caspian Transshipment Base
OPF: Onshore Processing Facilities

MAC: Marine Access Channels
RIWS: Russian Inland Water Way System

MARINE FLEET

NCOC
NORTH CASPIAN OPERATING COMPANY

64 owned units + 16 contracted = 80 marine units


ACV
Caspian Falcon


2nd SEP (Cargo Access)


3 Living Quarters Barges
NUR, SHAPAGAT & KARLYGASH


TR Barge
ZEROCK


Temporary Utility Barge


8 Ballastable Barges
5 LASHIN, 2 AKKU, Valentina


12 IBEEVS &
7 PONTOONS


6 Ice Protection Structures


OSR - 14 Boats & 14 Barges


ACB
Argymak


IBSSV TULPAR


3 Ice Breaking Vessels
MANGYSTAU 3. 4. 5


2 USDT Coastal Discovery and
Caspian Fauna

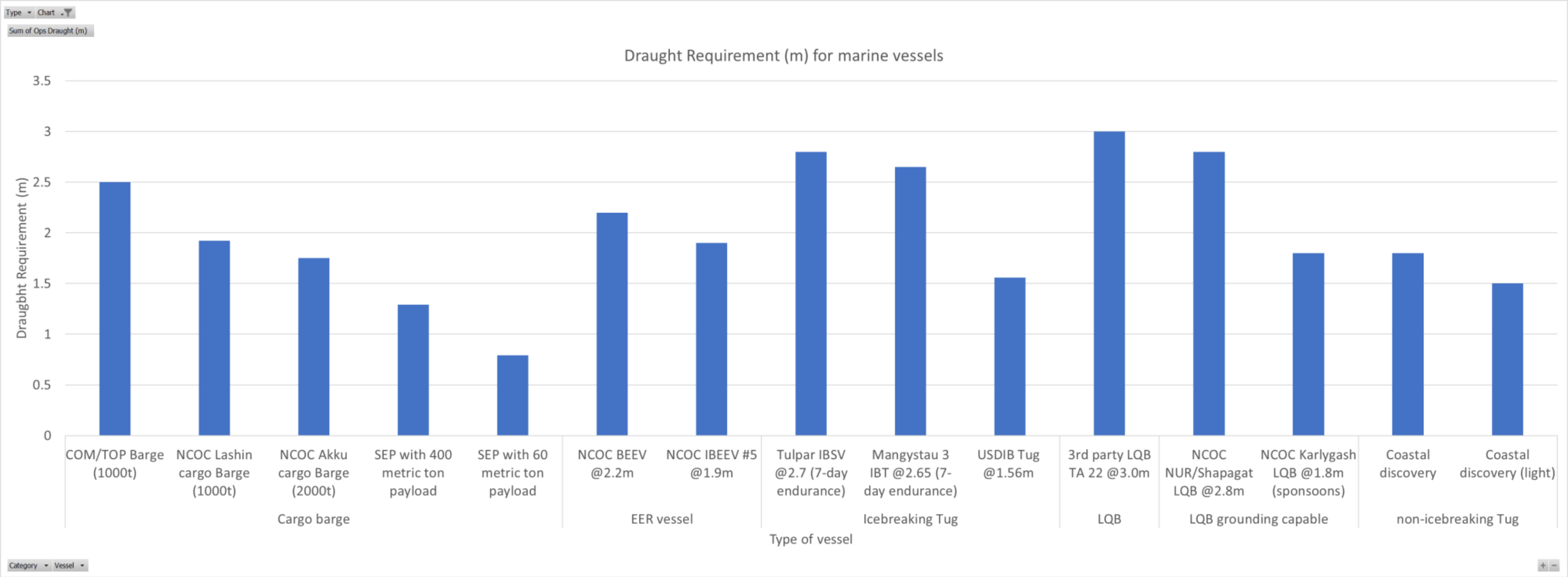

3 Ice Classed Flat Top Barges
COM6, TOP12, TOP14


1 x Ice Classed Liquid Bulk Barge
COM7


Veritas Pearl SEP
(diving inspection)


2 Marine Survey Vessels
Coastal Bigfoot & K.Balzhanov

DRAUGHT REQUIREMENT

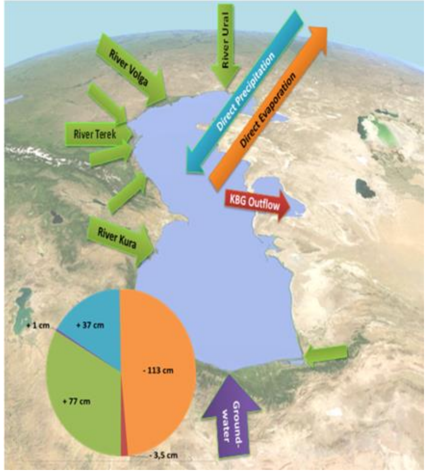


Technical limit reach for icebreaking tug: 1.5m

+ Under keel clearance (= Ice thickness)

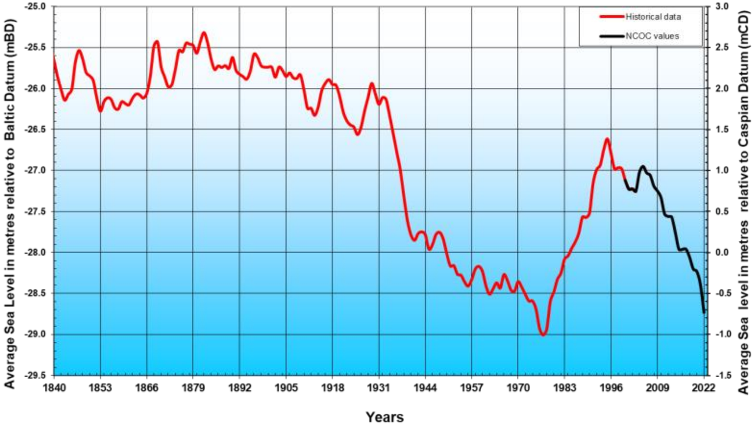
FALLING & FLUCTUATING CASPIAN SEA LEVELS

FALLING/FLUCTUATING CASPIAN SEA LEVELS (CSL)



Annual Mean Level Relative to Caspian Datum, [m]		
Year	NE Caspian	KE
2004	0.98	0.98
2005	1.05	0.99
2006	0.97	0.92
2007	0.94	0.92
2008	0.81	0.75
2009	0.75	0.71
2010	0.67	0.63
2011	0.47	0.43
2012	0.44	0.36
2013	0.43	0.44
2014	0.24	0.21
2015	0.04	0.03
2016	0.04	0.01
2017	0.04	0
2018	-0.06	-0.13
2019	-0.20	-0.23
2020	-0.23	-0.27
2021	-0.47	-0.5
2022	-0.73	-0.74

Caspian Sea level from 1840 to 2022



Note: Caspian Datum is -28m of Baltic Datum

There are three primary drivers are responsible for changes in Caspian Sea Level:

1. Seasonal variations (varies month by month);
2. Surges (wind induced surges varies by hour and day);
3. Long Term Trend (varies year by year).The Mean Sea level has decreased by 1.78 m since 2005 – Falling CSL.

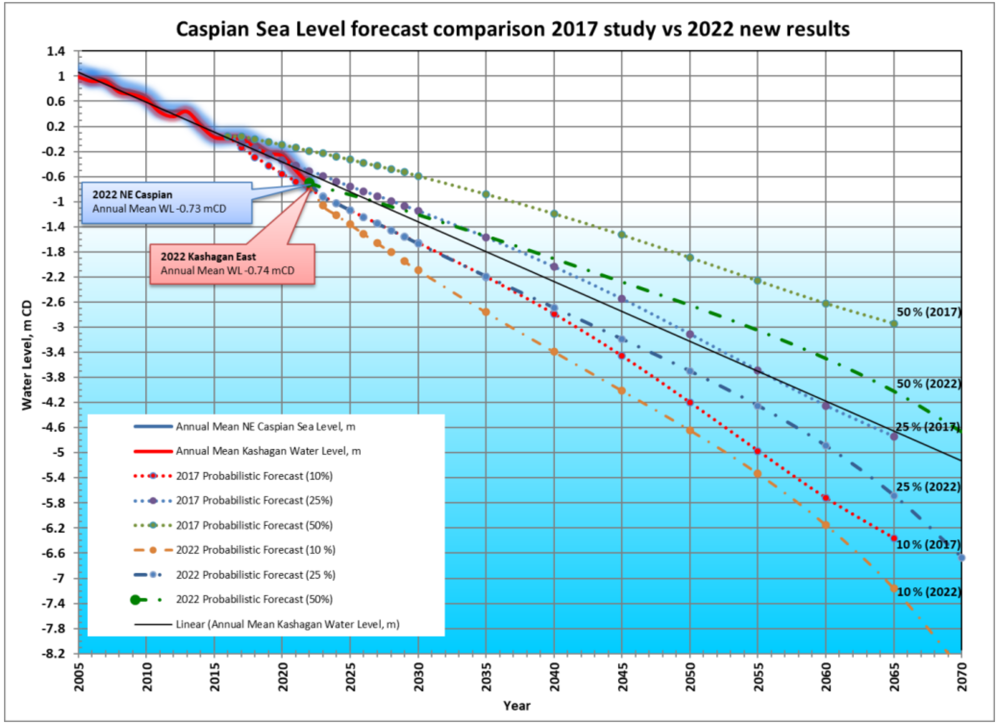
Consequences on the offshore supply chain?

1. Vessel downtime due to low water events along the transportation route leading ultimately to supply chain interruption.
2. Inability to deliver Roll-On/Roll-Off cargo when water level is too low against capability of Caspian ballast-able barges.
3. Risked volumes, incremental OPEX, additional CAPEX

The new 2022 study is based on Global Climate Models and following changes:

- Updated Greenhouse gas CO_2 emission scenarios in CMIP6 called 'Shared Socioeconomic Pathways' SSP 2-4.5 and SSP 5-8.5
- Selection of CMIP6 climate models based on SSP's and Model resolution over catchment area – only 100 km used
- Bias corrected direct precipitation, land precipitation over catchment area, sea surface evaporation
- Updated river run-off data for Volga, Ural, Kura and other River discharges
- Update of Kara-Bogaz Gol outflow predictions
- Human water extraction increased from 25 km3/year to 28 km3/year.

2022 LONG-TERM MODEL



Year	10%	25%	50%
2022	-0.7	-0.7	-0.7
2023	-1.06	-0.93	-0.78
2024	-1.21	-1.03	-0.83
2025	-1.36	-1.14	-0.89
2026	-1.51	-1.25	-0.95
2027	-1.66	-1.35	-1.01
2028	-1.8	-1.46	-1.08
2029	-1.95	-1.56	-1.14
2030	-2.09	-1.67	-1.21
2031	-2.23	-1.78	-1.27
2032	-2.36	-1.88	-1.34
2033	-2.5	-1.98	-1.41
2034	-2.63	-2.09	-1.48
2035	-2.76	-2.19	-1.55
2036	-2.89	-2.29	-1.62
2037	-3.02	-2.39	-1.69
2038	-3.15	-2.49	-1.77
2039	-3.27	-2.59	-1.84
2040	-3.39	-2.69	-1.91
2045	-4.01	-3.19	-2.28
2050	-4.64	-3.7	-2.65
2055	-5.33	-4.25	-3.05
2060	-6.15	-4.89	-3.5
2065	-7.16	-5.68	-4.02
2070	-8.46	-6.67	-4.67
2075	-10.14	-7.94	-5.49

New forecast 2022 results are lower, e.g.:

- P50: 0.55m lower than 2017 P50
- P25: 0.4m lower than 2017 P25

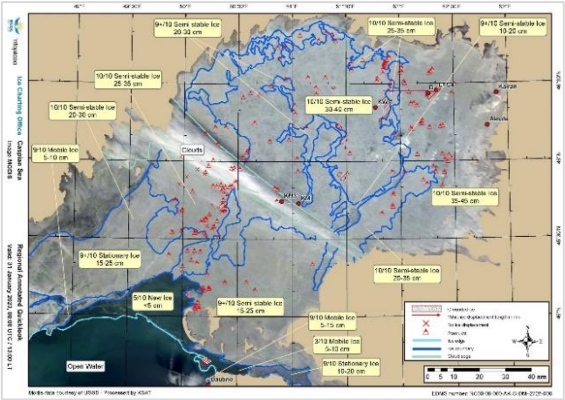
Probabilistic curve P25 is our Basis of Design (BoD)

Predicted rate of decline (2023-2050):

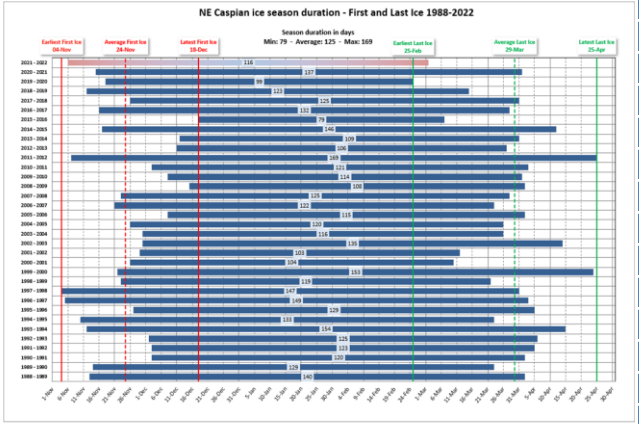
- P25 scenario: 10 cm
- P50 scenario: 7 cm

NE CASPIAN ICE ENVIRONMENT

NE Caspian Ice Extend 2022-2023 winter



NE Caspian Ice Season durations



KE Observed Ice Thickness

Year	Kashagan East	
	Level Ice, cm	Rafted Ice, cm
1999/2000	20	30-40
2000/2001		
2001/2002	40	
2002/2003	50	
2003/2004	30	
2004/2005	50	
2005/2006	55	120
2006/2007	25	60
2007/2008	65	80
2008/2009	50	100
2009/2010	60	70
2010/2011	35	55
2011/2012	65	78
2012/2013	53	80
2013/2014	57	84
2014/2015	50	87
2015/2016	25	40
2016/2017	50	60
2017/2018	50	60
2018/2019	26	60
2019/2020	15	25
2020/2021	43	50
2021/2022	28	35
Average	**43**	**66**

Data Sources and Ice Monitoring:

- Satellites images (Radarsat-2, TerraSARX, Sentinel-1 and 2, MODISA, LandSat, etc.)
- Helicopter Reconnaissance
- Instrumentation
  - Drift Buoys
  - Ice temperature profilers
  - UAV
  - Ice thickness profilers from vessel
- Standby vessels in KE
  - Direct observations during routine operations
  - Specific measurements when required

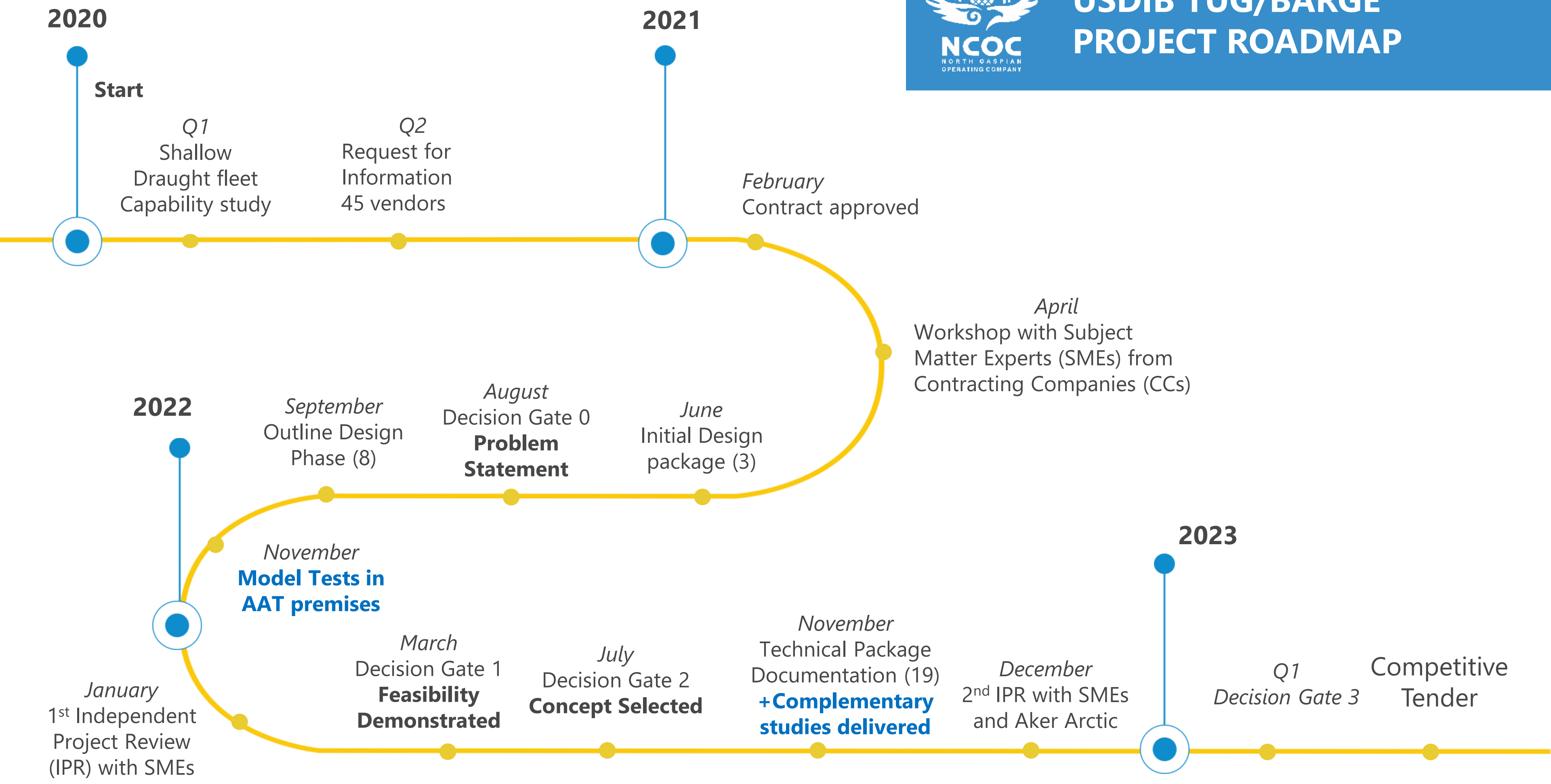
NCOC
NORTH CASPIAN
OPERATING COMPANY

USDIB Tug & Barge Project

OVERVIEW OF PROJECT ACTIVITIES

1. Setting the Basis of design
2. Designing Tug and Barge
3. Model testing of tug alone, tug and barge combination
4. Endurance study to confirm operability during severe winter
5. Under Keel Clearance study
6. Towing system study
7. Final selection of ship functions

USDIB TUG/BARGE PROJECT ROADMAP



SERVICES EXPECTED FROM VESSELS

#	Service
1	*Towing/pushing USD IB barges in open and closed water*
2	*Ice breaking duties + Leading convoys*
3	*Ice management*
4	*Open water tows (living quarter barges, heavy cargo barge…)*
5	*Supply chain for well interventions*
6	*Platform for stern mounted ice excavator*
7	*Zero discharge vessel*
8	*Certified to tow Dangerous Goods in towed barge*
9	Take part in Oil Spill and fire response plans

MODEL TESTS = 5 WEEKS

NCOC
NORTH CASPIAN OPERATING COMPANY

- **Ship models**
  - Tug
  - Tug+barge
    - Pushing
    - Pulling
- **Ice conditions**
  - Level ice
  - Managed brash ice
  - Ice rubble (turning)
  - Channel outbreaking
- **Direction**
  - Ahead
  - Astern (Tug)
- **Water depth**
  - Shallow water, 90 cm UKC
  - Shallow water, 130 cm UKC
  - Deep water

Purpose:

- Full scale tug's ice-going performance and steering capability.
- Full scale tug and barge's convoy performance and steering capability under different towing arrangements.
- Effect of **under keel clearance** (UKC) on tug and barge's performance in ice.

Results:

- UKC:
  - Theoretical performance predictions methods shows that ice breakers are not able to operate in conditions where ice thickness > UKC but Mangystau Ops data proves the opposite.
  - Analysis of Mangystau Ops data combined with ice model test analysis shows that USDIB Tug can operate in conditions where ice thickness is equal/less to under keel clearance.
- Towing Study:
  - Modifications to original design to comply with Industry standards and best practices – weight increase – Compatibility with existing NCOC Marine ops and vessels is confirmed.
- Endurance:
  - Calculated fuel load (without margins) varies between 15.8t (tug pushing barge, summer) to 49.1t (tug pulling barge, extreme ice conditions).
  - When tug is towing barge a convoy mode of operation with lead icebreaker is needed if ice thickness is more than 45cm or the towing tug will need more fuel load and draught will increase to more than 1.56 m.

Design Driver

The main driver is to break the 60 cm thickness, 500kPa flexural strength level ice (same as current Mangystau tugs) but with a lower operational draught.

Tug Main Particulars	GA
Length overall	50.2 m
Breadth	13.0 m
Draught, design	1.56 m
Draught, maximum	2.0 m
Bollard Pull	17 t
Deadweight @ 2.0m draught	296.4 t
Deadweight @1.5m draught	43.2 t

Barge Main Particulars	GA
Length overall	71.5 m
Breadth	14.5 m
Draught, design	1.5 m
Draught, maximum	2.0 m
Cargo deadweight @ 1.5m draught	TBC
Cargo deadweight @ 2.0m draught	TBC

Tug Design is based on Lloyd's Register Class with the following notations:

✠100A1, Tug, Caspian Sea Service, Icebreaker(+), Ice Class 1A FS, *IWS, LMC, UMS, Fire-fighting ship 1 (2400m3) with water spray

USDIB TUG/BARGE CHALLENGES

The whole approach to the project was different.

Instead of asking what size of vessel would be most suitable for the project, the project started with the question:
“Can you design an icebreaking tug that can break 60 cm ice at 1.5 m draught?”

- Requirements continued with:
  - … and to be able to tow a barge
  - … at 50 cm under keel clearance
  - … and have the endurance for a roundtrip during the most difficult ice season
  - … Fi-Fi capability and Cascade system

Main limitations affecting the project outcome

- water downtrend affecting the service time (“is there enough time to justify the investment?”)

Challenges

- Meet expectations from internal clients accustomed to use icebreaking vessels as “Swiss army knife” tool whilst the main driver of the project is to get a vessel with the minimum draught to break 60 cm of ice thickness
- Time to deliver

USDIB TUG/BARGE DRAWINGS

THANK YOU!

Contact Marine-OSR-IceMeteocean-Contracts@ncoc.kz