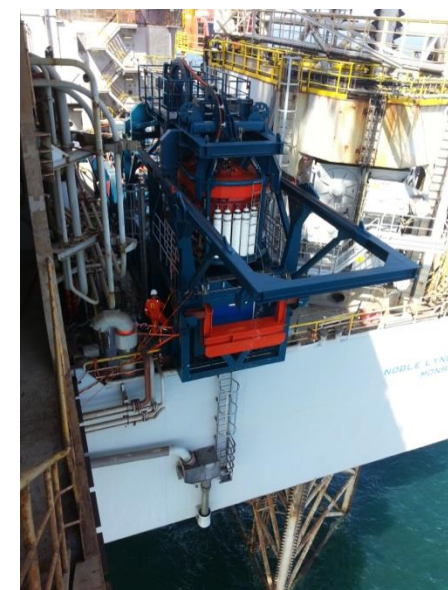


**WE ARE
SUBSEA:
THIS IS
OUR DOMAIN**

DELIVERING SUBSEA
PEOPLE / VESSELS / EQUIPMENT



TUP DIVING SYSTEM[®]





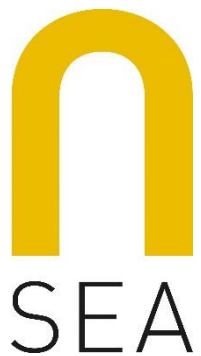
Content of presentation:

1. TUP principle (animation)
2. Bespoke TUP Scopes
3. Choice of breathing gasses
4. Practical 24-hour rotation comparison TUP vs Sur- D
5. Diver evacuation

IN

OUT





Project 1



Duration	23d OPS / 5d Mob / 3d Demob
Water Depth	37 msw
Bell Runs	85off
Diving Gas	Trimix (24% O2/50% N2/26% He)
Time on Bottom	102hr 47min
AVG Bell Run	1hr 12min
Project Team	30

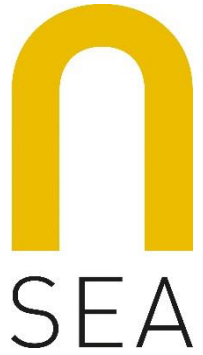
Operations	14%
Waiting on client	86%
Breakdown	0,16%
Weather / Tide	0,19%



Scope of Work:

Phase #1 – Top Hatch removal, Xmas Tree Inspection and Cleaning, Spool and Hose Installation and Pigging
Phase #2 – Pigging and Xmas Tree Abandonment



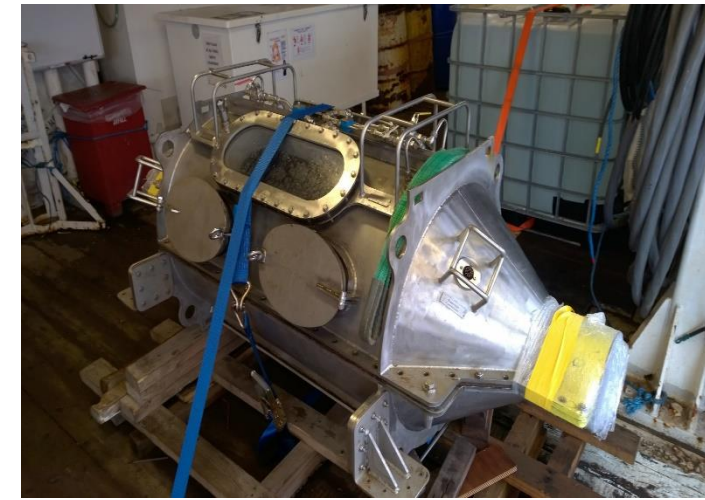


Project 2



Duration	27d OPS / 6d Mob / 3d Demob
Water Depth	26 msw
Bell Runs	146off
Diving Gas	Nitrox (35% O2/65% N2)
Time on Bottom	413hr 14min
AVG Bell Run	2hr 49min
Project Team	35

Operations	48%
Waiting on client	47%
Breakdown	0,63%
Weather / Tide	4,18%



Scope of Work:

Worlds first in-situ repair (in trench on seabed) of the Moyle Interconnector Power Cable





CHOICE OF DIVE GAS TO BE USED

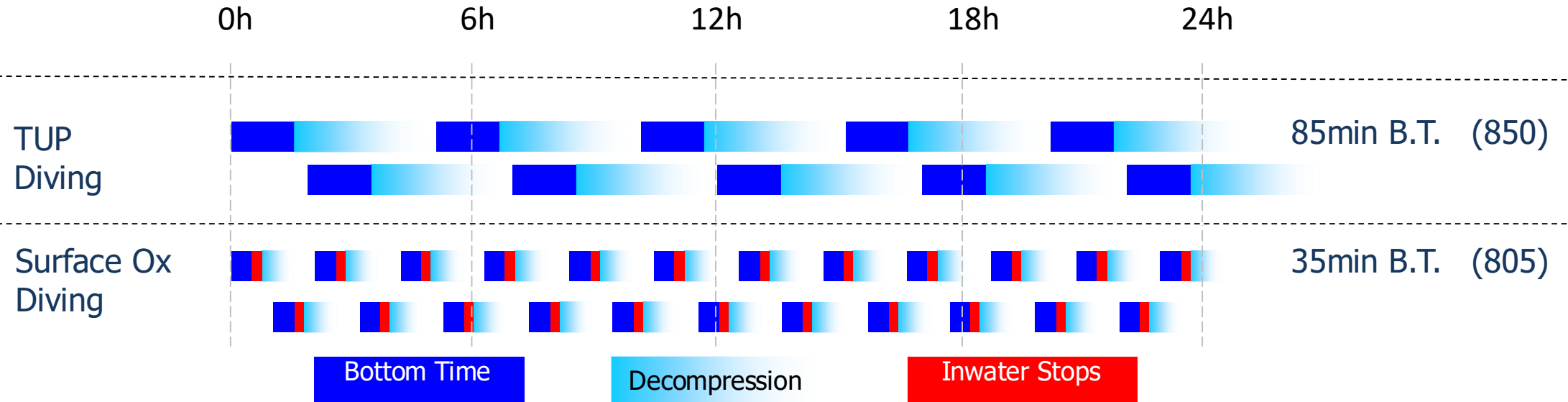
Gases used by N-Sea

- Air generally until 33msw
- Nitrox 15 to 37msw
- Trimix from 33 to 65 msw

Comparison decompression with gases
HELIOX 24-76 and Triox C2 110 minutes 39 msw

Stop depth	Stop time Heliox 24-76	Stop time Trimix 24-50-26
18	34	9
15	34	11
12	53	19
9	113	33
6	541	58
3	409	290
Total deco time	1187,9	423,9

PRACTICAL 24-HOUR ROTATION COMPARISON



SURFACE OX DIVING

23X Divers
2x Air Dive supervisor
1x Superintendent

WATER DEPTH 36MSW

49 Divers vs 33 Divers

TUP DIVING

20x Divers 10x Bellman
2x Closed bellsupervisor
1x Superintendent

TABLES USED FOR TUP VS SUR-D COMPARISON

Decompression tables for **TUP** diving on **AIR**
Pressures in MSW, times in minutes and tenth of minutes

Max dive depth **36 msw**
Ascent speed is max 10 msw/minute
Stop time starts after arrival at stop
REPETITIVE INTERVAL IS 16 HOURS

Code: AoxTUP2B
Copyright dadcodat 2013
version October 2014

Bottom time (min.)	Time till 1st stop (min.)	Stops in msw, time in min.													total deco time (min.)	total UPTD
		24 air	21 air	18 air	≤15 air TUP	15 oxy	12 air	12 oxy	9 air	9 oxy	6 air	6 oxy	3 air	3 oxy		
15	2.7				0-15				5	-	5	-	-	13.6	38	
30	2.4				0-15			5	-	5	-	5	-	10	28.6	81
45	2.1				0-15	10	5	10	-	10	5	10	-	-	53.6	147
60	2.1				0-15	10	5	10	-	10	5	10	-	15	68.6	184
75	2.1				0-15	10	5	10	-	10	5	20	5	15	83.6	217
90	2.1				0-15	10	5	10	-	10	5	20	5	30	98.3	253
105	1.8			1	0-15	10	5	20	5	20	5	20	5	30	124.6	319
120	1.8			6	0-15	10	5	20	5	20	5	30	5	35	144.6	361
130	1.8			9	0-15	10	5	20	5	20	5	30	5	40	152.6	379
140	1.8			12	0-15	10	5	20	5	20	5	30	5	50	165.6	403

DCD DECOMPRESSION TABLES 2015: *Revised NDC tables*

Copyright: DADCODAT 2015

air diving, surface decompression tables with oxygen

Code: **sox15**

maximum diving depth 36 metres

ascent speed is max. 10 metres/minute

stop time starts after arrival at stop

repetitive interval is 12 hours

dive time (min.)	till 1st stop	in water stops (metres)					stops in deco-chamber								tot. deco time (min.)	tot. OTU
		21 air	18 air	15 air	12 air	9 air	12 ox	9 air	9 ox	6 air	6 ox	3 air	3 ox			
10	3.6						10	-	-	-	-	-	-	14.8	38	
20	3.6						10	-	5	-	-	-	-	19.8	60	
30	2.4				2	1	10	-	10	5	10	-	-	42.8	100	
40	2.4				3	2	10	-	10	5	20	-	-	54.8	129	
50	2.1			1	4	4	20	5	20	5	10	-	-	73.8	170	
55	2.1			1	6	3	20	5	20	5	20	-	-	84.8	194	
60	2.1			1	7	4	20	5	20	5	20	5	5	96.8	206	



ADDITIONAL BOTTOM TIME

Table 1 Maximum bottom time limitation for surface decompression, in-water decompression, and transfer under-pressure decompression diving

Depth		Bottom time limits (minutes)		Air	Nitrox
Metres	Feet	Transfer under-pressure	Surface decompression and in-water decompression		
0-12	0-40	240	240	0	0
15	50	240	180	60	60
18	60	180	120	60	120
21	70	180	90	90	150
24	80	180	70	110	110
27	90	130	60	70	120
30	100	110	50	60	130
33	110	95	40	55	70
36	120	85	35	50	60
39	130	75	30	45	
42	140	65	30	35	
45	150	60	25	35	
48	160	55	25	30	
51	170	50	20	30	



TEAM REQUIREMENTS (MINIMAL)

- 4x Experienced Air diving supervisor. (For debate, does he require to be a Sat supervisor)
- 2x Experienced Deck Leader with air supervising qualifications.
- A well trained and educated team of divers, preferably with SAT experience.
- 2x Fully trained Dive technicians (hydraulics and electrics)
- Medical backup with knowledge about TUP decompression techniques.



DIVER EVACUATION THEORY

Methods of evacuation;

1. Hyperbaric evacuation with the divers remaining on storage depth (SAT Method)
2. Decompression in HRU during Hyperbaric evacuation
3. Evacuation to safe haven (next available chamber) on atmospheric pressure while breathing Oxygen



DIVER EVACUATION THEORY

1. Hyperbaric evacuation with the divers remaining on storage depth (SAT Method)

This is not a feasible option for the TUP diving tables because of the following;

1. Divers will be committing to saturation during the evacuation
2. OTU' uptake during the evacuation will continue.



DIVER EVACUATION THEORY

2. Decompression in HRU or SPHL during Hyperbaric evacuation

This option is “*possible*” for the TUP diving tables.

The divers will have to transfer to the HRU/SPHL under pressure via the chambers of the triple lock or the HRU/SPHL via a pressurized trunking.

Once the divers are in the HRU/SPHL and locked off the system the HRU/SPHL will be deployed into the water.

The divers in the HRU/SPHL will now start emergency decompression in the HRU until they are at 3 msw.

Positive points to this method.

1. Fast evacuation possible

Negative point to this method.

1. All risks associated with hyperbaric evacuation



DIVER EVACUATION THEORY

3. Evacuation to safe heaven (Next available chamber) on atmospheric pressure while breathing Oxygen

This option is possible for the TUP diving tables inline with the DVIS 5.

Calculations have shown that the M-Value of the dissolved gasses when following the DVIS 5 is such that the possibility of a DCI is limited.

This allows the divers to decompress (faster) to the surface and be evacuated to the next nearest decompression chamber.

Time allowed for evacuation at the end of a dive within the DVIS 5 limitations is 60 minutes, from the time that they reach the surface.

Positive points to this method.

1. Fast evacuation possible
2. No need to decompress during evac
3. Evacuate directly to treatment facilities
4. Safest evacuation route possible

Negative point to this method.

1. Divers will need treatment for omitted decompression.
2. Risk of DCI during evacuation



DIVER EVACUATION THEORY

Decompression tables for **TUP** diving on **AIR**
Pressures in MSW, times in minutes and tenth of minutes

Max dive depth **30 msw**
Ascent speed is max 10 msw/minute
Stop time starts after arrival at stop
REPETITIVE INTERVAL IS 16 HOURS

Code: AoxTUP2B
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version October 2014

Bottom time (min.)	Time till 1st stop (min.)	Stops in msw, time in min.												total deco time (min.)	total UPTD	
		24 air	21 air	18 air	≤15 air TUP	15 oxy	12 air	12 oxy	9 air	9 oxy	6 air	6 oxy	3 air			3 oxy
15	2.4				0-15						5	-	-	8.0	22	
30	2.1				0-15				5	-	5	-	10	23.0	60	
45	1.8				0-15		10	-	10	5	10	-	-	38.0	105	
60	1.8				0-15		10	-	10	5	10	-	10	48.0	131	
75	1.8				0-15		10	-	10	5	20	-	10	58.0	161	
90	1.8				0-15		10	-	10	5	20	5	20	73.0	187	
105	1.8				0-15		20	5	20	5	20	5	10	88.0	234	
120	1.5				0-15	10	5	20	5	20	5	20	5	15	108.0	284
135	1.5				0-15	10	5	20	5	20	5	20	5	25	118.0	310
150	1.5				0-15	10	5	20	5	20	5	20	5	35	128.0	335
165	1.5				0-15	10	5	20	5	20	5	30	5	40	143.0	373
180	1.5				0-15	10	5	20	5	20	5	30	5	50	153.0	399

Diver to Atmospheric P
Diver evac. on pure O₂
Recompress <**60**minutes

Diver to Atmospheric P
Diver evac. on pure O₂
Recompress <**15**minutes

Helicopter EVAC

Shore Based Treatment Facility

HRU using Bell, or

Heli / MOB EVAC

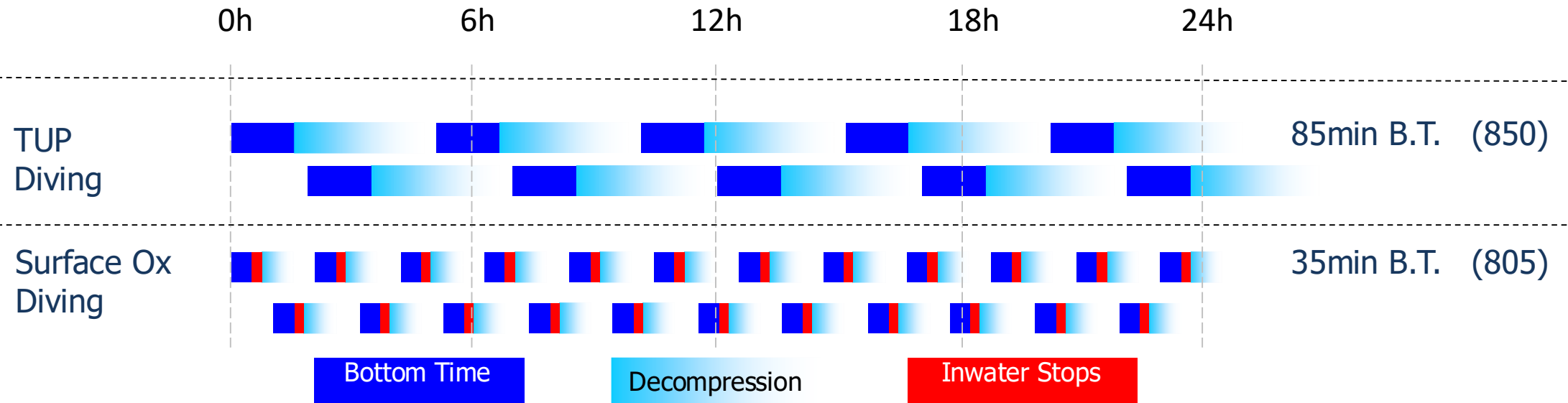
Offshore Based Treatment Facility



- How stable is the platform that is used.
- Will limiting the allowed weather/sea state criteria limit the likelihood of an evacuation event.
- What is expected timeline during a requirement for evacuation.
 1. Direct ? Will hyperbaric evacuation be feasible in that situation?
 2. 1 hours ? Divers will have completed approximately 50% of their deco.
 3. 2 hours ? Divers will have completed their decompression.
- How many divers will be exposed to the risk.
- What is the total duration of the risk.

How does this all, number of divers exposed, duration of risk period/evacuation and the events during evacuation, compare to hyperbaric evacuation ?

Duration and number of divers exposed to risk



SURFACE OX DIVING

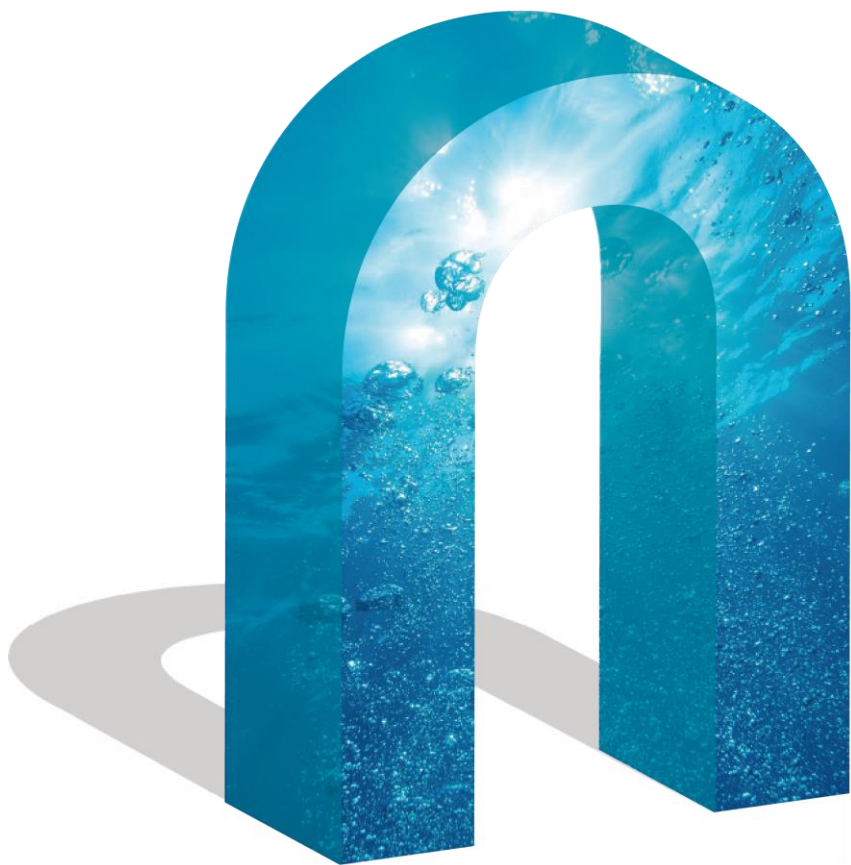
1265 minutes that divers are in decompression

WATER DEPTH 36MSW

49 Divers vs 33 Divers

TUP DIVING

950 minutes that divers are in decompression



**THANK YOU
FOR YOUR TIME
WE WELCOME ANY
QUESTIONS**

DELIVERING SUBSEA
PEOPLE / VESSELS / EQUIPMENT