


UNCLASSIFIED



Diving Medicine in Special Operations: A Special Tactics Perspective

H. Leo Tanaka, Maj, USAF, MC, SFS, DMO

24TH Special Operations Wing

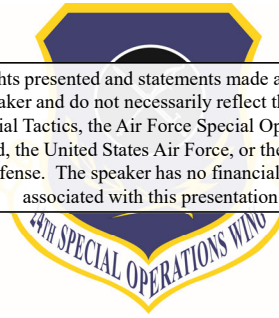
Air Force Special Tactics

UNCLASSIFIED

UNCLASSIFIED

Disclaimer

All thoughts presented and statements made are solely that of the speaker and do not necessarily reflect the position of Special Tactics, the Air Force Special Operations Command, the United States Air Force, or the Department of Defense. The speaker has no financial interests associated with this presentation.



UNCLASSIFIED

UNCLASSIFIED

24th Special Operations Wing

* The 24 SOW Mission is to: Conduct global air, space, and cyber-enabled special operations across the spectrum of conflict to prepare for, fight and win our nation's wars...Delivering superior performance to the nation in **global access, precision strike, personnel recovery and battlefield surgery**

FUNCTIONAL SUPPORT

- Air National Guard
- 123 STS (Stanford, KY)
- 326 STS (Kadena AB, Japan)
- 135 STS (Portland, Oregon)
- 321 STS (RAF Mildenhall, United Kingdom)

AFSOC

24 SOW
Hurlburt FLS, FL



24 SOW: 1916 personnel

- 258 officers
- 1515 enlisted
- 143 civilian
- CAO: 1 Oct 18

```



    graph TD
      AFSOC[AFSOC] --- 24SOW[24 SOW]
      24SOW --- 720STG[720 STG]
      24SOW --- STTrng[ST Training Sq]
      24SOW --- 724STG[724 STG]
      720STG --- 720OSS[720 OSS]
      STTrng --- SOTACC[SOTACC]
      STTrng --- SAS[SAS]
      724STG --- 724GSS[724 GSS]
      720OSS --- 17STG[17 STG]
      720OSS --- 21STG[21 STG]
      720OSS --- 22STG[22 STG]
      720OSS --- 23STG[23 STG]
      720OSS --- 26STG[26 STG]
      SOTACC --- 24STG[24 STG]
      SAS --- 24STG
      724GSS --- 24STG
      724GSS --- 27STG[27 STG]
      724GSS --- 28STG[28 STG]
      17STG --- 17STG
      21STG --- 21STG
      22STG --- 22STG
      23STG --- 23STG
      26STG --- 26STG
      24STG --- 24STG
      27STG --- 27STG
      28STG --- 28STG
  
```

UNCLASSIFIED

 **Diving Medicine** 



- Different Types of Diving
 - Open
 - SCUBA
 - FFM (MK 20)
 - Dry Suit
 - Closed Circuit
- Major Medical Conditions
 - DCI
 - AGE
- Medical Requirements
 - Medical Standards
 - Disqualifying Conditions

UNCLASSIFIED

 **ST Medicine** 

- Flight Surgeon
- Physician Assistant
- Independent Duty Medical Technician
 - Nurse
 - Paramedics
 - Medical Admin
 - Ops Psych
 - Social Worker
 - Physical Therapist
 - Athletic Trainer
 - Strength & Conditioning

UNCLASSIFIED


 **Why Important?** 

Video Courtesy of **LT Thijs Wingelaar, MD**
Dive Medical Physician, Diving and Submarine Medical Center, Royal Netherlands Navy



UNCLASSIFIED

UNCLASSIFIED




Blackhawk Crash

- March 10, 2015: 4 aircrew and 7 special operators on UH-60 lost in bad weather
- Army asked for USAF assistance on day 2; ST dive ops began day 3
- Navy UMO was on scene (stayed at morgue)
- Chamber was up 24/7 during 10 day operation
- 93% of human remains recovered
- 1400 mins of diving performed by 2 teams


UNCLASSIFIED

UNCLASSIFIED



Traditional DMO Pipeline


- Recognition and Treatment of Diving Injuries
 - Navy Standards
 - Chamber Time
 - Course for HMO/USA
- Naval Diving and Salvage Training Center
 - SCUBA
 - FFM MK 20
 - KM 37 Hard Hat, Surface Supplied
 - (Just Added Closed Circuit Fam)
 - Course for UMO/USN; DMO/USA



(9 Weeks)


UNCLASSIFIED

UNCLASSIFIED




AFSOC ST DMO Pipeline

- NOAA Diver Modules 1-3
 - SCUBA
 - Full Face Mask
 - Drysuit
 - Nitrox
 - Special Tasks (lift bags, search and recovery, pneumatic tools)
- Recognition & Treatment of Diving Injuries (NDSTC)
 - Navy Standards
 - Chamber Time



3 Weeks




2.5 Wks

- Familiarization for MK 25
 - Medicine
 - Building Rig and Diving

(2 Days)

UNCLASSIFIED

UNCLASSIFIED




Operational Effects

- Closed Circuit Dive Mishap
- USAF Combat Diver on Vacation
- Special Tactics Assessment and Selection
- Special Tactics Pre-Scuba Course
- Thai Cave Mission

UNCLASSIFIED

UNCLASSIFIED




SOF Closed Circuit Case

- Who: Special Operator
- What: Possible O2 toxicity, DCS type II, treated for DCS as worst possible scenario
- When: Autumn timeframe
- Where: East Coast
- Why: During a night 1500M Drager navigation dive, diver surfaced with a **headache and tunnel vision**. He was given a neurological exam by the DMT, and at first they did not notice any neurological deficiencies. He became increasingly irritable, and the DMT continued neuro exams. When taken to shore, the DMT noticed a "deficiency with his gait," and then another deficiency with his finger to nose test. **They placed him on O2 and he immediately started to feel nauseous.** Due to having 2 neurological deficiencies, he was **taken to the chamber**. The day before, 19 OCT the team did chamber training with other military divers, with max dive at 130 feet. This dive was also one of the reasons why they wanted to rule out DCS. Max depth and bottom time for the dive where the incident occurred was 18 feet for 15 minutes. This was the 5th Closed Circuit navigation dive of the day. They did 2 x 500m day nav dives, 1 x 1500m day nav dive, and 1 x 500m night nav dive prior. Total time on O2 for the day was 125 minutes.

UNCLASSIFIED




UNCLASSIFIED



No DCI in Closed Circuit

- May Dive up to 20 FSW for up to 240 mins, OR maximum of 50 FSW for 10 minutes.
- Before diving, purge procedure required to ensure breathing 100% O2
- If purge is done properly, nitrogen has been removed from circuit and DCS risk lowered
- Primary concerns are O2 Toxicity or possibly AGE
- Oxygen "off-effect"
- If combat diver has increased physical exertion, can potentially have retained CO2 in rig

UNCLASSIFIED

 **ST Combat Diver on Vacation**   

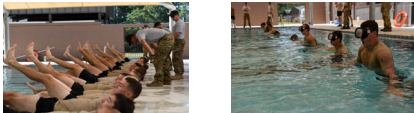
- ST member went on vacation to Europe
- Stayed beyond No Decompression limits
- Developed extremity pain that worsened
- Went to chamber

Table #1: UNCLASSIFIED (and other) Personal Data (Approved by the Department of State)

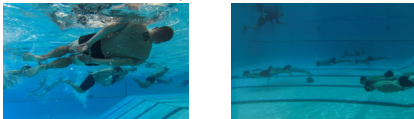
Name	Age	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height	Weight	Height
1. [Name]	28	175	5'10"	180	5'11"	185	6'0"	190	6'1"	195	6'2"	200	6'3"	205	6'4"	210	6'5"	215	6'6"
2. [Name]	30	180	6'0"	185	6'1"	190	6'2"	195	6'3"	200	6'4"	205	6'5"	210	6'6"	215	6'7"	220	6'8"
3. [Name]	32	185	6'1"	190	6'2"	195	6'3"	200	6'4"	205	6'5"	210	6'6"	215	6'7"	220	6'8"	225	6'9"
4. [Name]	34	190	6'2"	195	6'3"	200	6'4"	205	6'5"	210	6'6"	215	6'7"	220	6'8"	225	6'9"	230	6'10"
5. [Name]	36	195	6'3"	200	6'4"	205	6'5"	210	6'6"	215	6'7"	220	6'8"	225	6'9"	230	6'10"	235	6'11"
6. [Name]	38	200	6'4"	205	6'5"	210	6'6"	215	6'7"	220	6'8"	225	6'9"	230	6'10"	235	6'11"	240	7'0"
7. [Name]	40	205	6'5"	210	6'6"	215	6'7"	220	6'8"	225	6'9"	230	6'10"	235	6'11"	240	7'0"	245	7'1"
8. [Name]	42	210	6'6"	215	6'7"	220	6'8"	225	6'9"	230	6'10"	235	6'11"	240	7'0"	245	7'1"	250	7'2"
9. [Name]	44	215	6'7"	220	6'8"	225	6'9"	230	6'10"	235	6'11"	240	7'0"	245	7'1"	250	7'2"	255	7'3"
10. [Name]	46	220	6'8"	225	6'9"	230	6'10"	235	6'11"	240	7'0"	245	7'1"	250	7'2"	255	7'3"	260	7'4"
11. [Name]	48	225	6'9"	230	6'10"	235	6'11"	240	7'0"	245	7'1"	250	7'2"	255	7'3"	260	7'4"	265	7'5"
12. [Name]	50	230	6'10"	235	6'11"	240	7'0"	245	7'1"	250	7'2"	255	7'3"	260	7'4"	265	7'5"	270	7'6"
13. [Name]	52	235	6'11"	240	7'0"	245	7'1"	250	7'2"	255	7'3"	260	7'4"	265	7'5"	270	7'6"	275	7'7"
14. [Name]	54	240	7'0"	245	7'1"	250	7'2"	255	7'3"	260	7'4"	265	7'5"	270	7'6"	275	7'7"	280	7'8"
15. [Name]	56	245	7'1"	250	7'2"	255	7'3"	260	7'4"	265	7'5"	270	7'6"	275	7'7"	280	7'8"	285	7'9"
16. [Name]	58	250	7'2"	255	7'3"	260	7'4"	265	7'5"	270	7'6"	275	7'7"	280	7'8"	285	7'9"	290	7'10"
17. [Name]	60	255	7'3"	260	7'4"	265	7'5"	270	7'6"	275	7'7"	280	7'8"	285	7'9"	290	7'10"	295	7'11"
18. [Name]	62	260	7'4"	265	7'5"	270	7'6"	275	7'7"	280	7'8"	285	7'9"	290	7'10"	295	7'11"	300	8'0"
19. [Name]	64	265	7'5"	270	7'6"	275	7'7"	280	7'8"	285	7'9"	290	7'10"	295	7'11"	300	8'0"	305	8'1"
20. [Name]	66	270	7'6"	275	7'7"	280	7'8"	285	7'9"	290	7'10"	295	7'11"	300	8'0"	305	8'1"	310	8'2"
21. [Name]	68	275	7'7"	280	7'8"	285	7'9"	290	7'10"	295	7'11"	300	8'0"	305	8'1"	310	8'2"	315	8'3"
22. [Name]	70	280	7'8"	285	7'9"	290	7'10"	295	7'11"	300	8'0"	305	8'1"	310	8'2"	315	8'3"	320	8'4"
23. [Name]	72	285	7'9"	290	7'10"	295	7'11"	300	8'0"	305	8'1"	310	8'2"	315	8'3"	320	8'4"	325	8'5"
24. [Name]	74	290	7'10"	295	7'11"	300	8'0"	305	8'1"	310	8'2"	315	8'3"	320	8'4"	325	8'5"	330	8'6"
25. [Name]	76	295	7'11"	300	8'0"	305	8'1"	310	8'2"	315	8'3"	320	8'4"	325	8'5"	330	8'6"	335	8'7"
26. [Name]	78	300	8'0"	305	8'1"	310	8'2"	315	8'3"	320	8'4"	325	8'5"	330	8'6"	335	8'7"	340	8'8"
27. [Name]	80	305	8'1"	310	8'2"	315	8'3"	320	8'4"	325	8'5"	330	8'6"	335	8'7"	340	8'8"	345	8'9"
28. [Name]	82	310	8'2"	315	8'3"	320	8'4"	325	8'5"	330	8'6"	335	8'7"	340	8'8"	345	8'9"	350	8'10"
29. [Name]	84	315	8'3"	320	8'4"	325	8'5"	330	8'6"	335	8'7"	340	8'8"	345	8'9"	350	8'10"	355	8'11"
30. [Name]	86	320	8'4"	325	8'5"	330	8'6"	335	8'7"	340	8'8"	345	8'9"	350	8'10"	355	8'11"	360	9'0"
31. [Name]	88	325	8'5"	330	8'6"	335	8'7"	340	8'8"	345	8'9"	350	8'10"	355	8'11"	360	9'0"	365	9'1"
32. [Name]	90	330	8'6"	335	8'7"	340	8'8"	345	8'9"	350	8'10"	355	8'11"	360	9'0"	365	9'1"	370	9'2"
33. [Name]	92	335	8'7"	340	8'8"	345	8'9"	350	8'10"	355	8'11"	360	9'0"	365	9'1"	370	9'2"	375	9'3"
34. [Name]	94	340	8'8"	345	8'9"	350	8'10"	355	8'11"	360	9'0"	365	9'1"	370	9'2"	375	9'3"	380	9'4"
35. [Name]	96	345	8'9"	350	8'10"	355	8'11"	360	9'0"	365	9'1"	370	9'2"	375	9'3"	380	9'4"	385	9'5"
36. [Name]	98	350	8'10"	355	8'11"	360	9'0"	365	9'1"	370	9'2"	375	9'3"	380	9'4"	385	9'5"	390	9'6"
37. [Name]	100	355	8'11"	360	9'0"	365	9'1"	370	9'2"	375	9'3"	380	9'4"	385	9'5"	390	9'6"	395	9'7"
38. [Name]	102	360	9'0"	365	9'1"	370	9'2"	375	9'3"	380	9'4"	385	9'5"	390	9'6"	395	9'7"	400	9'8"
39. [Name]	104	365	9'1"	370	9'2"	375	9'3"	380	9'4"	385	9'5"	390	9'6"	395	9'7"	400	9'8"	405	9'9"
40. [Name]	106	370	9'2"	375	9'3"	380	9'4"	385	9'5"	390	9'6"	395	9'7"	400	9'8"	405	9'9"	410	9'10"
41. [Name]	108	375	9'3"	380	9'4"	385	9'5"	390	9'6"	395	9'7"	400	9'8"	405	9'9"	410	9'10"	415	9'11"
42. [Name]	110	380	9'4"	385	9'5"	390	9'6"	395	9'7"	400	9'8"	405	9'9"	410	9'10"	415	9'11"	420	10'0"
43. [Name]	112	385	9'5"	390	9'6"	395	9'7"	400	9'8"	405	9'9"	410	9'10"	415	9'11"	420	10'0"	425	10'1"
44. [Name]	114	390	9'6"	395	9'7"	400	9'8"	405	9'9"	410	9'10"	415	9'11"	420	10'0"	425	10'1"	430	10'2"
45. [Name]	116	395	9'7"	400	9'8"	405	9'9"	410	9'10"	415	9'11"	420	10'0"	425	10'1"	430	10'2"	435	10'3"
46. [Name]	118	400	9'8"	405	9'9"	410	9'10"	415	9'11"	420	10'0"	425	10'1"	430	10'2"	435	10'3"	440	10'4"
47. [Name]	120	405	9'9"	410	9'10"	415	9'11"	420	10'0"	425	10'1"	430	10'2"	435	10'3"	440	10'4"	445	10'5"
48. [Name]	122	410	9'10"	415	9'11"	420	10'0"	425	10'1"	430	10'2"	435	10'3"	440	10'4"	445	10'5"	450	10'6"
49. [Name]	124	415	9'11"	420	10'0"	425	10'1"	430	10'2"	435	10'3"	440	10'4"	445	10'5"	450	10'6"	455	10'7"
50. [Name]	126	420	10'0"	425	10'1"	430	10'2"	435	10'3"	440	10'4"	445	10'5"	450	10'6"	455	10'7"	460	10'8"
51. [Name]	128	425	10'1"	430	10'2"	435	10'3"	440	10'4"	445	10'5"	450	10'6"	455	10'7"	460	10'8"	465	10'9"
52. [Name]	130	430	10'2"	435	10'3"	440	10'4"	445	10'5"	450	10'6"	455	10'7"	460	10'8"	465	10'9"	470	10'10"
53. [Name]	132	435	10'3"	440	10'4"	445	10'5"	450	10'6"	455	10'7"	460	10'8"	465	10'9"	470	10'10"	475	10'11"
54. [Name]	134	440	10'4"	445	10'5"	450	10'6"	455	10'7"	460	10'8"	465	10'9"	470	10'10"	475	10'11"	480	11'0"
55. [Name]	136	445	10'5"	450	10'6"	455	10'7"	460	10'8"	465	10'9"	470	10'10"	475	10'11"	480	11'0"	485	11'1"
56. [Name]	138	450	10'6"	455	10'7"	460	10'8"	465	10'9"	470	10'10"	475	10'11"	480	11'0"	485	11'1"	490	11'2"
57. [Name]	140	455	10'7"	460	10'8"	465	10'9"	470	10'10"	475	10'11"	480	11'0"	485	11'1"	490	11'2"	495	11'3"
58. [Name]	142	460	10'8"	465	10'9"	470	10'10"	475	10'11"	480	11'0"	485	11'1"	490	11'2"	495	11'3"	500	11'4"
59. [Name]	144	465	10'9"	470	10'10"	475	10'11"	480	11'0"	485	11'1"	490	11'2"	495	11'3"	500	11'4"	505	11'5"
60. [Name]	146	470	10'10"	475	10'11"	480	11'0"	485	11'1"	490	11'2"	495	11'3"	500	11'4"	505	11'5"	510	11'6"
61. [Name]	148	475	10'11"	480	11'0"	485	11'1"	490	11'2"	495	11'3"	500	11'4"	505	11'5"	510	11'6"	515	11'7"
62. [Name]	150	480	11'0"	485	11'1"	490	11'2"	495	11'3"	500	11'4"	505	11'5"	510	11'6"	515	11'7"	520	11'8"
63. [Name]																			

Pulmonary Edema in SOF

- Assessments (Pool Sessions)



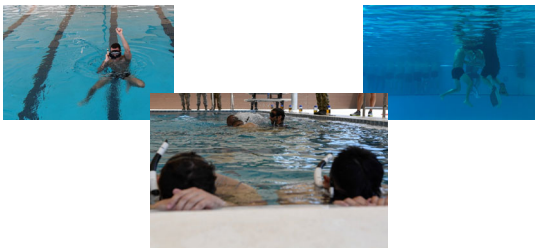
- Swimming Induced Pulmonary Edema (SIPE)
- Immersion Pulmonary Edema



UNCLASSIFIED

Snorkel Pulmonary Edema

- Negative Pressure Pulmonary Edema




UNCLASSIFIED

Incidence of SIPE

- <10% of candidates develop
- Spectrum of disease
- Some need inpatient care
- Risk Factors
 - Temperature
 - Fluid Intake
 - Activity
- Symptoms
- Signs


UNCLASSIFIED



Loss of Consciousness

UNCLASSIFIED

- During Underwaters
- “Shallow Water Blackout”
- Hypoxic Loss of Consciousness
- Not usually indicative of underlying disease

UNCLASSIFIED





Thai Cave Mission

UNCLASSIFIED

- June 23, 2018
- 08-10 JULY 2018
- 12 Thai boys and their soccer coach trapped in flooded cave system
- 320 STS/31 RQS tasked to assist with rescue/recovery

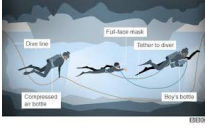



UNCLASSIFIED

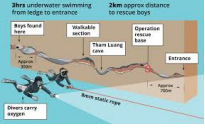



Open Source Reporting

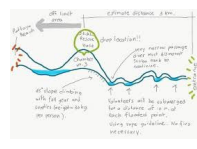
UNCLASSIFIED




Dive in, Full-face mask, Surface to dive, Compressed air bottle, Boy's buddy



3km underwater swimming from ledge to entrance, 2km approx distance to rescue boys, Ripon Head cave, Walkable section, Operation rescue base, Then Laung cave, Entrance, River Main type, Divers entry point



All 'low' of oxygen with 100 psi and inflator the gas is by an inflator.
 Operators will be surprised that a distance of 2 m of backflow is possible. When now available, the ERS is necessary.

UNCLASSIFIED


Thai Cave Diagram

Section	Approx. Distance	Current Conditions
9 → 8	350m	All underwater
8 → 7	150m	Dry
7 → 6	250m	All underwater
6 → 5	350m	Airspace overhead, swimmable
5 → 4	200m	All underwater
4 → 3	150m	All underwater

Staging Points

UNCLASSIFIED

Thai Cave Dive Med


- AFSOC medics on ground
- PJs and CCTs diving SCUBA from Chamber 3
- Closest Chamber is Bangkok
- Hypothermia (water temp 6° C)
- Illnesses
- FFM on unconscious diver
- Rescuer Fatality
- Near Drowning of Second Thai Diver

UNCLASSIFIED


Thai Cave Mission

- Tham Luang Cave Rescue
- MSgt Derek Anderson (PJ)
- 1530-1600
- Ballroom B
- Track 2: TEMS

UNCLASSIFIED



Dive Med Impacts on Mission

UNCLASSIFIED


24 SOW Dive Medicine Statement:

Provide Special Tactics medics for rapid global employment to enable full spectrum combat dive operations

<p><i>* Decades of dive experience operationally</i></p> <p><i>* Traditionally relied on Navy for support... Special Tactics DMO can fulfill dive medical support for future operations, allowing freedom of maneuver</i></p> <ul style="list-style-type: none"> - Initial training costs for 1x DMO ~\$1.5K - Annual training costs for 1x DMO ~\$200 - Time to produce DMO ~6 wks <p><i>* Manning across force currently is roughly at 20%</i></p>	<p><u>Effects of Dive Med to operations:</u></p> <ul style="list-style-type: none"> - More dive training expertise: RISK TO FORCE ↓ - Dive-specific support for SOF team: RISK TO MISSION ↓ <p><u>Role of Dive Medicine is to maintain capability:</u></p> <ul style="list-style-type: none"> - Injury prevention / avoidance - Rapid, proper diagnosis/treatment of dive injuries - Quicker return to duty - Mission flexibility and completion
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

UNCLASSIFIED



Future

UNCLASSIFIED



- AFI 10-3501 Rewrite Ongoing
- DMT Pipeline
 - 5 weeks dry
 - Marine Combat Diver
- Portable Chamber
 - US Navy
 - USAF
 - DAN
 - Aircraft Carriers/Subs
- UHM fellowship trained expert






UNDERSEA & HYPERBARIC MEDICAL SOCIETY


UNCLASSIFIED



Acknowledgments

UNCLASSIFIED


- Mr. Raynold Augustin
- LtCol Alex Keller
- Col John Wightman
- Col John Dorsch
- MSgt Derek Anderson
- TSgt Kenneth O'Brien
- Mr. Mike Gray
- Dr. Michael Ott
- LtCol Stephen Rush
- LCDR Brian Keuski
- LT Christopher Manganello



UNCLASSIFIED
