Preparation and Implementation of a 53.5 Hour Saturation Dive; Tech Perspective

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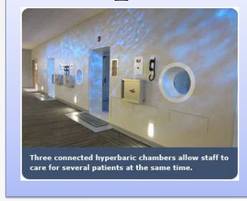

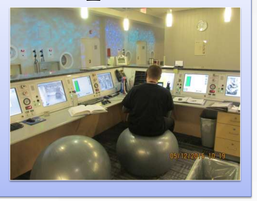

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Background:

64 y/o adult male had a planned dive using USN Rev 6 table 220/20 on Air with a scheduled total ascent time of 87 minutes and 20 seconds. Diver forgot his weight belt, after roughly 18 minutes at 220 fsw, the diver lost buoyancy control and surfaced in roughly 3 minutes. Bilateral lower extremity paralysis developed and the diver was taken to a local monoplace chamber for a TT6. Treatment was aborted due to patient vomiting. The diver's symptoms persisted, a second TT6 was administered some 13 hours later but patient status continued to worsen. DAN was contacted and patient was flown to HCMC. Patient treatment began at HCMC multiplace chamber T32 hours after incident.

Both HCMC facilities department and medical gas vendor were notified prior to the start of dive to ensure adequate amounts of gas could be available upon request within a timely manner. A roll-call of available Staff members was discussed with availability to relieve core department personnel. A list of area chambers was provided to Medical Direction overseeing dive. Emergency compressor vendors were notified along with a 24 hour emergency contact number. Pre-dive briefing with all core department personnel involved with the dive was had. Emergency procedures were relayed to both Supervising MD and Tech.

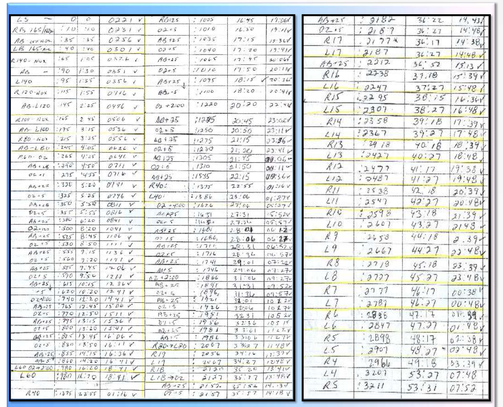
Methods:

Fink TL20-171 (The Rat Pack) is a three lock chamber. Lock 1 (Frank) has a max treatment depth of 66 fsw whereas locks 2 (Sammy) and 3 (Dean) have a max treatment depth of 165 fsw. Medical gases include: Medical Air, Oxygen, Heliox 80/20, Nitrox 50/50, Nitrogen, and Special Mix capable. Pre-dive briefing to discuss tables, ascent rates, lock-in/outs, staffing changes, emergency procedures, and other subjects related to the longevity of this dive. On Sept, 20th 2014 at 0221, pressurization began to 165 fsw for TT6A, then was transitioned into TT4, and ending with a TT7 on Sept 22, at 0752. Total Time of Dive was 3211 minutes. The dive was overseen by an MD, operator, and tender, that were on site for the entire duration of the tx. Eight extra attendants were locked-in on 13 different occasions and three extra chamber operators filled in for the core operator during rests.

Equipment and Suppliers:

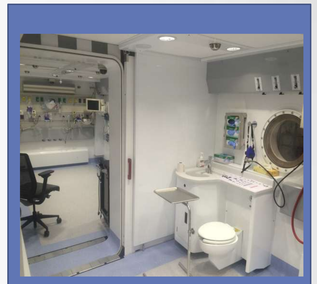
- **Compressor capabilities**
  - One Primary Compressor
    - Atlas Copco Oil-Free Rotary screw
    - Capable of 151 psi output
    - Set at 141 psi out (+/- 10 psi)
    - Connected to hospital emergency power
  - One back-up compressor
    - Atlas Copco Oil-free Rotary Screw
    - Capable of 151 psi output
    - Set at 121 psi (+/- 10 psi)
    - Connected to hospital emergency power
  - Two 620 gallon air receivers (1240 total volume)
- **Emergency back-up power**
  - Hospital emergency back-up power (generator)
  - 1- 6 kva UPS battery back-up for chamber controls
  - 1- 3 kva UPS battery back-up for manual chamber controls
  - 1- 3 kva UPS battery back-up for FSS controls
- **Medical gas quantities / receiving emergent gas**
  - Medical Air
    - Two banks of 8 "H" cylinders (16 total) for Primary use
    - Two banks of 8 "H" cylinders (16 total) for back-up
    - 6 Spare "H" cylinders
    - Hospital stocks spare "H" cylinders
      - Call was made to hospital Facilities Management 12 hours prior to start of dive for confirmation and validation of emergent med gas delivery and heads up
    - 24 hour emergency Medical Gas delivery via gas vendor
  - Ascent controls via control computer
- Nitrogen
  - Two liquid VGL Nitrogen tanks for primary use
  - Three "H" cylinders for primary back-up
  - Four "H" cylinder for reserve back-up
  - Hospital stocks spare VGL's tanks
    - Call was made to hospital Facilities Management 12 hours prior to start of dive for confirmation and validation of emergent med gas delivery and heads up
  - 24 hour emergency Medical Gas delivery via gas vendor
    - Call was made to Med Gas vendor 12 hours prior to start of dive for confirmation and validation of emergent med gas delivery and heads up
- Heliox
  - Four "H" cylinders for primary use
  - 24 hour emergency Medical Gas delivery via gas vendor
    - No emergent back-up from med gas vendor due to special order mix
- Nitrox
  - Four "H" cylinders for primary use
  - Four cylinders spare
  - 24 hour emergency Medical Gas delivery via gas vendor
    - No emergent back-up from med gas vendor due to special order mix

Master Dive Log:

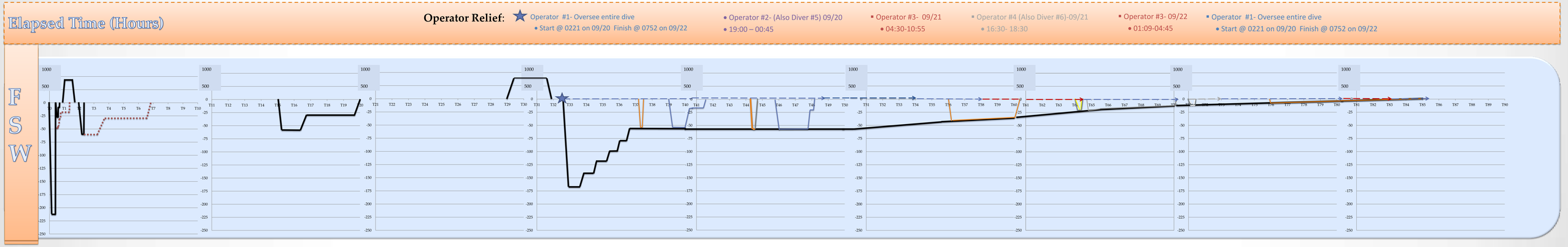


Conclusion:

Saturation dives can be intimidating and complex, but with continuous training, a detailed plan and a committed staff, saturation dives can be executed with confidence.



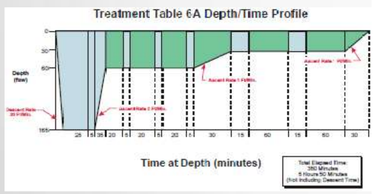
Elapsed Time (Hours)

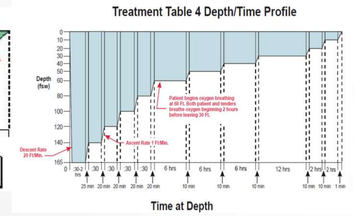


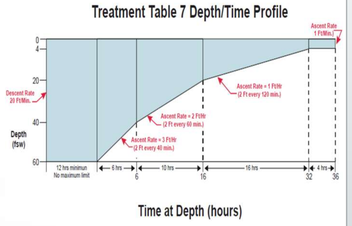
Operator Relief:

- ★ Operator #1- Oversee entire dive
  - Start @ 0221 on 09/20 Finish @ 0752 on 09/22
- Operator #2- (Also Diver #5) 09/20
  - 19:00 – 00:45
- Operator #3- 09/21
  - 04:30-10:55
- Operator #4 (Also Diver #6)-09/21
  - 16:30- 18:30
- Operator #3- 09/22
  - 01:09-04:45
- Operator #1- Oversee entire dive
  - Start @ 0221 on 09/20 Finish @ 0752 on 09/22

Treatment plan: USN 6A,TT4, and TT7:







- **Staff dive log:**
  - 1 staff member completed full dive (Primary)
  - 1 staff member completed 4 dives
  - 5 staff members completed 1 dive each
  - 1 staff member completed 3 dives
  - Only during 1 lock-in/lock-out was a staff member a repet diver
    - ★Staff #1 (Primary)
      - 72 plus hours clear from repet dive (CLEAR)
      - LS @ 0221 on 09/20
      - RS @ 0752 on 09/22
      - 3211 minutes Total Time of Dive
      - USN Table 6A,4,7
    - Lock-in Staff # 2
      - 72 plus hours clear of repet dive (CLEAR)
      - LS @ 0734 on 09/20
      - RS @ 0752 on 09/20
      - USN 60/17
    - Lock-in Staff #3
      - 72 plus hours clear of repet dive (CLEAR)
      - LS @ 0842 on 09/20
      - RS @ 1105 on 09/20
      - USN 60/110
    - Lock-in Staff #2
      - Repet diver "C"
      - LS @ 1114 on 09/20
      - RS @ 1131 on 09/20
      - USN 60/22
    - Lock-in Staff #4
      - 72 plus hour clear of repet dive (CLEAR)
      - LS @ 1114 on 09/20
      - RS @ 1131 on 09/20
      - USN 60/17
    - Lock-in Staff #5
      - 24 plus hour clear of repet dive (CLEAR)
      - LS @ 1610 on 09/20
      - RS @ 1833 on 09/20
      - USN 60/110
    - Lock-in Staff # 4
      - 24 plus hours clear repet dive (CLEAR)
      - LS @ 0118 on 09/21 RS @ 0550 on 09/21
      - USN 40/240
    - Lock-in Staff #2
      - 13 hours and 13 minutes plus repet dive (CLEAR)
      - LS @ 0951 on 09/21
      - RS @ 1009 on 09/21
      - USN 25/20
    - Lock-in Staff #8
      - 72 plus hours clear repet dive (CLEAR)
      - LS @ 0951 on 09/21
      - RS @ 1009 on 09/21
      - USN 25/20
    - Lock-in Staff #6
      - 24 plus hour clear of repet dive (CLEAR)
      - LS @ 1026 on 09/21
      - RS @ 1614 on 09/21
      - USN 25/354
    - Lock-in Staff # 2
      - 6 plus hours clear of repet dive (CLEAR)
      - LS @ 1635 on 09/21
      - RS @ 1649 on 09/21
      - USN 20/26
    - Lock-in Staff # 7
      - 72 plus hours clear repet dive (CLEAR)
      - LS @ 1635 on 09/21
      - RS @ 1649 on 09/21
      - USN 20/26
    - Lock-in Staff #4
      - 16 hours 10 minutes clear repet dive (CLEAR)
      - LS @ 2212 on 09/21
      - RS @ 0752 on 09/22
      - USN 10/580

Kudos!

Kimberlee Nerling, Christopher Logue, Joe Harris, Jason Benson, Evan McKay, Thomas Masters, Greg Brown, Steve Omodt, and the entire Hennepin County Medical Center Hyperbaric Department.