



**Probability and Severity**  
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# Editorial

Welcome to the second special edition of *Tech Diving Mag*.

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This special edition contains a book excerpt from the revised edition of *Deep Into Deco: The Diver's Decompression Textbook*, which has been released earlier this year, along with an article shedding lights on the efforts exerted to rescue Thailand cave kids and their coach.

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In case you don't know, [Ultimate Planner](#) has been updated to accommodate for the M11F6 algorithm, in addition to the already-existing VPM-B and ZH-L16. Determined by late Dr. Bill Hamilton and colleagues during the development of decompression tables for the Swedish Navy, M11F6 has worked well for both nitrox and trimix diving. Download your free, Lite version and give it a play.

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This is very much your magazine. If you want to share some views or decided you want to get an article you've authored published to an audience of thousands of technical -and wanna-be technical- divers, drop a line to [asser@techdivingmag.com](mailto:asser@techdivingmag.com). And please subscribe to the newsletter at [www.techdivingmag.com/communicate.html](http://www.techdivingmag.com/communicate.html) to receive a brief email reminder when new issues are available for download.



Asser Salama  
Editor, *Tech Diving Mag*

## Probability and Severity

By Asser Salama

In 2017, a study investigating a new method to predict the probability of DCS was published. Case reports for 3322 air and nitrox dives resulting in 190 DCS events were retrospectively analyzed and the outcomes were scored as the following:

1. serious neurological
2. cardiopulmonary
3. mild neurological
4. pain
5. lymphatic or skin
6. constitutional or nonspecific manifestations.

Following standard U.S. Navy medical definitions, the data were grouped into mild (Type I: manifestations 4–6) and serious (Type II: manifestations 1–3). The researchers also considered an alternative grouping of mild (Type A: manifestations 3–6) and serious (Type B: manifestations 1 and 2). The current U.S. Navy guidance allows for a 2% probability of mild DCS and a 0.1% probability of serious DCS. Alternatively, the researchers developed a hierarchical trinomial (3-state) probabilistic model that simultaneously predicts the probability of mild and serious DCS given a dive exposure.<sup>1</sup> Both the Type I/II and Type A/B discriminations of mild and serious DCS resulted in a highly significant improvement in trinomial model fit over the binomial (2-state) model. According to the presented results, it would be better to replace the currently used DCS / No-DCS model and consider a new one employing Serious-DCS / Mild-DCS / No-DCS.

Instead of planning your dive the way you do right now, you would enter your accepted risks of serious and mild DCS. The lower your accepted risks are, the longer the generated schedule would be.

## References

1. Howle LE, Weber PW, Hada EA, Vann RD, Denoble PJ. The probability and severity of decompression sickness. PLoS ONE 12(3):e0172665. <https://doi.org/10.1371/journal.pone.0172665>.

Excerpted from the revised edition of *Deep Into Deco: The Diver's Decompression Textbook*. The title is available at:

<https://www.bestpub.com/component/hikashop/product/deep-into-deco-the-diver-s-decompression-textbook-revised-edition.html?Itemid=2561>

<https://www.amazon.com/Deep-Into-Deco-Decompression-Textbook/dp/1947239090>



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"As divers push the boundaries of traditional recreational diving limits, the value of a comprehensive yet immensely readable source of information has become paramount. *Deep Into Deco* Second Edition is an outstanding compendium of information on decompression history, theory, and practice. It also contains supporting information from many of the diving world's most knowledgeable pioneers and innovators."

-Dan Orr, President Emeritus of Divers Alert Network (DAN)

"*Deep Into Deco* is a stimulating read which covers almost every facet of diving from breathing to technical decompression. It is well referenced and dives into (forgive the pun) great detail concerning the past and present of diving theories. I recommend this book for all divers from novice to technical expert because Asser Salama makes even the most difficult topics seem easy and understandable. No diving collection is complete without this super overview book. I will keep mine on the coffee table as a discussion piece."

— Commander Joseph Dituri,

US Navy Saturation Diving Officer (ret) and Vice President of IANTD

"This book is long overdue. And it's worth the wait. What Asser Salama has accomplished with this book is remarkable. He has taken that early history of experimental trial and error and produced a stunning reference text that brings the science into sharp focus."

—Bret Gilliam, founder of TDI

This second edition of *Deep Into Deco* has been fully updated to reflect the latest research outcomes. Chapter summaries have been added to give a quick overview of each chapter. A new section on nitrogen and helium kinetics has been added as well as a second appendix for calculating the acceleration in post-diving no-fly time associated with breathing surface oxygen.



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DEEP INTO DECO: THE DIVER'S DECOMPRESSION TEXTBOOK

# DEEP INTO DECO

REVISED & UPDATED

The Diver's  
Decompression  
Textbook

Asser Salama



ป้ายหน้า  
บริษัท

**Thailand Cave Rescue  
By Bruce Konefe**

On 23 July around 1 pm 12 kids of the “Wild Boar” soccer team and their coach had entered Tham Luang Cave located in Chang Rai Thailand. The kids ages ranged from 11-16 years old and their coach being 25. The boys had entered the cave and were trapped from rising waters blocking their exit. None of these kids would realize that they would not be coming out of the cave for another couple weeks.

Two days after the kids were discovered missing, a group of cave divers and instructors based in Thailand and myself volunteered to assist the Thai Navy seals in rescuing the kids from the cave. All the volunteer members of the cave diving group have many years experience diving in strong flow, low visibility and in small hole restrictions. The equipment we used to reach the kids was open circuit sidemount configuration, front mounted closed circuit rebreathers and sidemounted closed circuit rebreathers.

During this rescue, the volunteer group stayed in a restricted area working directly with the Thai Navy seals, Australian Police Special Forces and the US Military. Our group basically consisted of underwater cave specialists who were there to help educate proper cave protocols and emergency procedures. Our group was split into two basic groups. One team was to help locate the boys and the other to work bringing them out.

On day nine the kids were discovered about 5 km inside the cave. During the first week before the kids were found, our team was in contact with doctors and cave rescue experts. The survivability reports that were given to us were not very positive. We were highly surprised at the conditions of the kids after being found. All 12 kids and the coach were in fairly good condition for being without food and limited water for so long.

At this point the job was only half completed. First thing that had to be done was to get a doctor to where the kids were at to evaluate their condition. Food and medical supplies had to be brought to the kids to help strengthen them. We had to sit down and come up with a plan to bring the kids out of the cave safely. Many ideas were brought up on how to rescue them as far as drilling through the top or finding another exit. As cave divers our job was to bring them out of the cave. We had discussed many ways and had to come up with a way that we believe to be the safest. This plan was then taken to the Thai Navy Seals and they would decide the final plan.

At this point of the rescue we were fighting many elements and one of the biggest problems was the weather. During this time of the year the season is rainy, and rain seemed to never stop. Each day the team continued to move forward preparing to bring the kids out. Laying the guidelines; tanks, food and medical supplies had to be brought into the cave in preparation. The Army and National Park had brought in geologists to help divert water from the top of the mountains. Without their effort the water levels wouldn't go down. There was a final break in the weather where the rain stopped and the water levels dropped in the cave.

At this point everything was put in place and it was time to start bringing out the boys. All of the tanks were staged at the air pockets area and the teams were assigned specific duties. Each day would allow enough time to bring out 4 of the boys and on the last day 4 boys and the coach. The kids wore a full face mask and were brought out by diving until chamber 3 then transferred onto a stretcher. There were teams set up along the way to transfer them to the next dry section. As each boy exited out the cave they were taken to the hospital to be evaluated and looked after by the doctors. All of the boys and the soccer coach were brought out safely.



One thing that I did learn from this rescue is team effort and working together with other teams. There is no way that this rescue could have been a success without all of the teams working together.

There is one true hero of this rescue and that would be Saman Kunan, a former Thai Navy Seal diver who died in the rescue of the boys trapped in a cave. My condolences to the family and friends of Saman Kunan.

This rescue could have never been a success without the help of everyone involved in the rescue. Claus Rasmussen, Por Parasu, Vsevolod Korobov, Ruengrit Changkwanueng (Pae), Mikko Passi, Ben Reymenants, Maksym Polejaka, Ivan Karadzic, Nick Vollmar, Erik Brown, Narinthorn Na Bangchang and Pichamon Changkwanueng.

Thanks to all of the people and companies that helped donate money, equipment and time to the rescue. There were so many people involved in the rescue and I would like to thank everyone who had participated. If I did not have your name down please forgive me.

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