21. Underwater Cave Surveying Diver

21.1 Introduction

This course is designed to give the trained cave diver the minimum knowledge and basic fundamentals of how to survey in the unique underwater cave environment. The intention of this program is to encourage standardization of cave surveying on all projects; encourage the use of cave maps in dive planning while increasing the diver's awareness and knowledge of the surroundings in this environment. Safe techniques, procedures and skill perfection associated with surveying in cave diving is emphasized.

21.2 Who May Teach

This course may be taught by any active TDI Underwater Cave Surveying Instructor.

21.3 Qualifications of Graduates/Limits of Training

Upon successful completion of this course, graduates may engage in cave surveying diving activities without direct supervision, so long as the following limits are adhered to:

1. Penetration is limited to one-third air rule, or more conservative air-plan at the instructor's discretion.
2. 39 Metres/ 130 Feet maximum depth.
3. 6 Metres/20 Feet minimum starting visibility.
4. No equipment removal in the cave.
5. Students are encouraged to gain experience before attempting to plan and execute complex cave dives.
6. Perform safety and decompression stops appropriate or necessary.

21.4 Student to Instructor Ratio

Academic:

1. Unlimited, so long as adequate facilities, supplies and time are provided to ensure comprehensive and complete training of subject matter.

Confined Water (swimming pool-like conditions):

1. N/A.

Open Water (ocean, lake, quarry, spring, river, or estuary):

1. A maximum of 2 students per instructor; it is the instructor's discretion to reduce this number as conditions dictate.

21.5 Student Prerequisites

1. Minimum age 18.
2. Provide proof of a TDI Full Cave Diver certification or equivalent.
3. Provide proof of at least 25 non-training full cave dives.

21.6 Course Structure and Duration

Open Water Execution:

1. TDI allows instructors to structure courses according to the number of students participating and their skill level. Adequate time to ensure comprehension and ability to perform skills is required.

Course Structure:

1. Two survey cave dives are required with a minimum accumulated bottom time of 60 minutes.

Duration:

1. The suggested number of classroom and briefing hours is 8; minimum number of days to complete the program is 2.

21.7 Administrative Requirements

Administrative Tasks:

1. Collect the course fees from all the students.
2. Ensure that the students have the required equipment.
3. Communicate the schedule to the students.
4. Have the students complete the:
    a. *TDI Liability Release and Express Assumption of Risk* Form.
    b. *TDI Medical Statement* Form.

Upon successful completion of the course the instructor must:

1. Issue the appropriate TDI certification by submitting the *TDI Diver Registration* Form to TDI Headquarters or registering the students online through member's area of the TDI website.

21.8 Required Materials

1. Basic Underwater Cave Surveying by John Burge, NSS-CDS.
2. Note pad and pencils.
3. Basic calculator (can square and exact square roots) or scientific calculator.
4. Scaling ruler.
5. Graph paper.
6. Circular protractor.

21.9 Required Equipment

The following equipment is required for each student:

1. Primary cylinders, minimum volume is 22 litres/160 cubic ft, manifold system recommended.
2. Two independent first and second stage regulators; one regulator equipped with a long hose.
3. Submersible pressure gauge.
4. Buoyancy compensator device (BCD) with power inflator.
5. Exposure suit adequate for diving environment.
6. Mask and fins, NO snorkel.
7. Line cutting device.
8. Three battery powered lights; 1 primary and 2 back-ups, each with a burn time suitable for the planned dive time.
9. Slate or wet notes with a pencil.
10. Submersible dive tables or backup dive computer.
11. Safety reel with a minimum of 37 Metres/125 Feet of guideline.
12. One primary cave-diving reel with length appropriate for intended dive.
13. Jump/Gap reel 15 Metres/50 Feet of line.
14. Three directional line arrows.

15. One non-directional marker.
16. Underwater compass and bulls-eye level mounted on slate.

Note: It is recommended the team pre-position decompression cylinders approximately 1 stop deeper than the planned decompression depth on any dive where decompression is planned. Cylinders should be clearly marked and easily identifiable, even in non-visibility conditions. Each cylinder must have a regulator and submersible pressure attached.

Note: It is recommended the instructor have oxygen and a first aid kit available for surface support. In addition, adequate drinking fluids should be available for all students, instructional staff, and surface support personnel to prevent dehydration.

21.10 Required Subject Areas

The following topics must be covered during this course:

1. Decompression Theory and its Application to Survey diving.
2. Gas Matching Procedures/Management.
3. Accident Analysis.
4. Equipment Considerations:
    a. Compass readings.
    b. Compass errors.
    c. Streamlining.
5. Body Posture and Buoyancy Control.
6. Survey Techniques:
    a. Sketching.
    b. Tie-off stations.
    c. Vertical surveying.
    d. Large chambers.
    e. Extended passages.
    f. Radial surveys.
7. Review of Problem Solving:
    a. Emergency procedures:
        i. Line following.
        ii. Team separation.

iii. Communication.

8. Survey Process:
    a. Data collection.
    b. Data verification.
    c. Data preparation.
9. Symbolism.
10. Cartography:
    a. Single line maps.
    b. High grade maps.
11. Cave Environment/Conservation.
12. Landowner Relations.
13. Local Access Requirements.

21.11 Required Skill Performance and Graduation Requirements

The student must complete the following in-water skills during the survey cave dives:

1. Demonstrate adequate pre-dive planning.
2. Equipment check, and S-drill should be second nature with each dive.
3. Demonstrate proper use of guideline and reels.
4. Students are to critique their own dives while the instructor supervises this process.
5. The maximum depth for this course is 40 Metres/130 Feet.

Note: A continuous guideline to open water must be maintained on all cave dives.

Note: A reckless or cavalier attitude may constitute grounds for denying certification, regardless of technical ability.

Note: Certifications may be denied if it is determined the course was not conducted according to the standards established by TDI.

In order to complete the course, the student must:

1. Complete all land drills and cave dive requirements safely and efficiently.
2. Demonstrate mature and sound judgment, concerning dive planning and execution.

3. Maintain an appropriate level of awareness and respect for the cave environment.
4. Log all dives.
5. Receive the recommendation for certification by the instructor.

21.12 Instructor Requirements

To qualify to teach the TDI Cave Survey Diver Course, the instructor must:

1. Be an active TDI Full Cave Diving Instructor for at least 1 year.
2. Have taught at least 5 complete cave diver courses.
3. Provide proof of at least 25 logged survey dives.
4. Co-taught at least 1 TDI Underwater Cave Survey Diver Course with an active TDI Underwater Cave Survey Diver Instructor.
5. Published or be a key member of at least 1 cave survey project.