

### 3.2.13 Underwater Cave Survey

#### 3.2.13.1 Course Outcomes

GUE's Underwater Cave Survey course is designed to introduce experienced cave divers to the important skill of surveying underwater caves. Among the course's intended outcomes are: introducing divers to the basic principles of underwater cave survey, the implementation of a defined team approach to underwater survey data collection, preparing an experienced cave diver to productively assist in a coordinated cave project, and introducing divers to cartography methods.

#### 3.2.13.2 Prerequisites

Applicants for an Underwater Cave Survey course must abide by [Training Prerequisites \(2.1.4.1\)](#), plus:

- a. Be a minimum of 18 years of age. Documented parental or legal guardian consent must be submitted to GUE HQ when the participant is a minor.
- b. Hold a GUE Cave Diver Level 2 certification.
- c. Have conducted at least 25 non-training Cave 2 dives following completion of GUE Cave Diver Level 2 certification.
- d. Students participating in an Underwater Cave Survey course conducted utilizing DPVs must hold a GUE Diver Propulsion Vehicle Cave certification.
- e. If using a drysuit during the course, have conducted at least 25 non-training dives in a drysuit or have conducted 15 non-training dives utilizing a drysuit following completion of GUE Drysuit Primer certification.

#### 3.2.13.3 Course Content

The Underwater Cave Survey course is normally conducted over five days. It requires a minimum of ten diving hours and at least forty hours of instruction, encompassing lectures, land drills, and in-water work.

#### 3.2.13.4 Underwater Cave Survey Specific Training Standards

- a. Student-to-instructor ratio is not to exceed 4:1 during land drill or surface exercises; it cannot exceed 2:1 during any in-water training.
- b. Maximum depth of 100 ft/30 m.
- c. Maximum of 1/3 of the total gas supply can be used for cave penetration.
- d. Minimum 140 ft<sup>3</sup>/4000 L of gas is required to begin an UW Cave Survey training dive.
- e. All survey tasks must be completed before reaching penetration gas limits.
- f. No DPV diving unless taught by an Active GUE DPV Cave instructor.
- g. Students must complete GUE Rescue Primer or equivalent from a recognized training agency prior to certification.

#### 3.2.13.5 Required Training Materials

GUE training materials and recommended study as determined by the course study packet available online or via download after GUE course registration.

### 3.2.13.6 Academic Topics

- a. Introduction
- b. Course overview
- c. Reasons to survey
- d. Survey priorities
- e. Equipment
- f. Data collection
- g. The “stick map”
- h. Data archiving
- i. Data manipulation and plotting
- j. Expanding the frame
- k. Sketching underwater details
- l. Cartography
- m. Overview of workflow
- n. GUE and underwater cave survey

### 3.2.13.7 Land Drills and Topics

- a. Handling survey equipment
- b. Basic line survey
- c. Division of team responsibilities
- d. Measurements and estimates
- e. Communication
- f. Recording data
- g. Extremity data collection
- h. Survey line installation
- i. Sidewall and interior sketching
- j. Post survey archiving
- k. Data manipulation and plotting
- l. Cartography and map production

### 3.2.13.8 Required Dive Skills and Drills

Students must demonstrate competence in the following skills to attain GUE Underwater Cave Survey certification:

- a. Must be able to swim at least 500 yds/450 m in under 14 minutes without stopping. This test should be conducted in a swimsuit and, where necessary, appropriate thermal protection.
- b. Must be able to swim a distance of at least 60 ft/18 m on a breath hold while submerged.
- c. Demonstrate a safe and responsible demeanor throughout all training.
- d. Demonstrate basic equipment proficiency and an understanding of the GUE equipment configuration.
- e. Demonstrate proficiency in safe diving techniques, including pre-dive preparation, in-water activity, and post-dive assessment.
- f. Demonstrate awareness of team member location and a concern for safety, responding quickly to visual indications and dive partner needs.
- g. Demonstrate proficiency in underwater communication.

- h. Demonstrate safe ascent and descent procedures.
- i. Demonstrate good buoyancy and trim, i.e., approximate reference is a maximum of 20 degrees off horizontal while remaining within a range of 3 ft/1 m from target depth.
- j. Demonstrate proficiency in all aspects of Cave 2 level diving under survey conditions. These include, but are not limited to: guideline installation and retrieval, underwater communication, decompression, stability and trim, complex navigation, propulsion, bottom stage and decompression stage management, stress management while task loaded, and gas management.
- k. Demonstrate proficiency in effectively performing all tasks associated with a team survey.
- l. Demonstrate proficiency in the use of survey equipment.
- m. Effectively take measurements and estimates.
- n. Demonstrate consistent, clear, and concise underwater data recording.

### 3.2.13.9 Equipment Requirements

GUE double tank configuration as outlined in Appendix A, plus:

- a. One safety spool
- b. One primary reel per team
- c. One exploration reel per team capable of holding a minimum of 800 ft/240 m of knotted line
- d. One primary and two backup lights
- e. At least twelve line markers; six directional and six non-directional
- f. Survey package: Each student must have a survey compass, prepared underwater survey notes, spare pencils, and a prepared 3 ft/1 m measuring string.
- g. One “open reel” design fiberglass tape per team, measuring between 100 ft/30 m and 170 ft/51 m
- h. One handheld underwater sonar per team

Excluding:

- a. Surface marker buoy with spool

Additionally, when diving with a DPV:

- a. One GUE-approved DPV
- b. At least one spare GUE-approved DPV per team

Prior to the commencement of the class, students should consult with a GUE representative to verify equipment requirements and the appropriateness of any selected equipment.

## Appendix A - GUE Equipment Configuration

The GUE base equipment configuration is comprised of:

- a. Tanks/cylinders: Students may use a single tank/cylinder with a single- or dual-outlet valve. Students may also use dual tanks/cylinders connected with a dual-outlet isolator manifold, which allows for the use of two first stages. Dual tanks/cylinders connected with a dual-outlet, non-isolator manifold can be used, but only in recreational (minimum

decompression) diving, and are considered an alternative for a single tank/cylinder. Consult course-specific standards and your instructor to verify size requirements.

- b. Regulators:
  - i. Single tank: The first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose. A backup second stage must be necklaced and supplied via a short hose. The first stage must also supply an analog pressure gauge, inflation for the buoyancy compensator (BC), and (when applicable) inflation for a drysuit.
  - ii. Double tank: One first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose (7 ft/2 m hose is required for all cave classes), and inflation for the buoyancy compensator (BC). The other first stage must supply a necklaced backup second stage via a short hose, an analog pressure gauge, and (when applicable) inflation for a drysuit.
- c. Backplate system:
  - i. Is held to the diver by one continuous piece of webbing. This webbing is adjustable and uses a buckle to secure the system at the waist.
  - ii. A crotch strap is attached and looped through the waistband to prevent the system from riding up a diver's back.
  - iii. The continuous webbing must support five D-rings;
    - 1. The first placed at the left hip
    - 2. The second placed in line with a diver's right collarbone
    - 3. The third placed in line with the diver's left collarbone
    - 4. The fourth and fifth are placed on the front and back of the crotch strap when divers plan to use advanced equipment such as DPVs.
  - iv. The harness below the diver's arms has small restrictive bands to allow for the placement of backup lights. The webbing and system retains a minimalist approach.
- d. Buoyancy compensation device (BC):
  - i. A diver's BC is back-mounted and minimalist in nature.
  - ii. It is free of extraneous strings, tabs, or other material.
  - iii. There are no restrictive bands or restrictive elastic affixed to the buoyancy cell.
  - iv. Wing size and shape is appropriate to the cylinder size(s) employed for training.
- e. At least one time/depth measuring device
- f. Wrist-mounted compass
- g. Mask and fins: Mask is low-volume; fins are rigid, non-split.
- h. Backup mask
- i. At least one cutting device
- j. Wetnotes with at least one pencil
- k. Exposure suit appropriate for the duration of exposure
- l. Surface marker buoy (SMB) with spool: Where required, the SMB should be appropriate for environmental conditions and deployed using a spool with at least 100 ft/30 m of line.

**The GUE PSCR configuration is comprised of:**

- a. GUE base equipment configuration (except Tanks/Cylinder)
- b. One primary and two backup lights
- c. A GUE-approved passive semi-closed circuit rebreather

- d. Modified tank configuration as appropriate for use with a GUE-approved passive semi-closed circuit rebreather
- e. Modified regulator configuration as appropriate for use with a GUE-approved passive semi-closed circuit rebreather

**The GUE CCR configurations are comprised of:**

- a. GUE base equipment configuration (except Tanks/Cylinder, where relevant)
- b. One primary and two backup lights
- c. A GUE-approved closed-circuit rebreather
  - i. Where required, students must own a GUE-approved closed-circuit rebreather before attending the course; they can, however, use a rented or borrowed unit during the course.
  - ii. The closed-circuit rebreather used by the student, with all associated components, must be fully functional (pass all tests on the rebreather pre-dive checklist) and serviced according to manufacturer specifications.
  - iii. All analog oxygen sensors must be less than one year from manufacturing date.
  - iv. All electronic components, including but not limited to the rebreather controller unit and monitoring systems, must be updated with the latest software and firmware versions published by the manufacturer.
- d. Modified tank configuration as appropriate for use with a GUE-approved closed-circuit rebreather
- e. Modified regulator configuration as appropriate for use with a GUE-approved closed-circuit rebreather
- f. Spare parts and consumables, including one set of appropriate batteries; one oxygen sensor; and one DSV/BOV mouthpiece.
- g. If using a drysuit inflation cylinder attached to the backplate, extended inflation cylinder straps need to be used to ensure that it does not interfere with or restrict the counterlung's function.

**The GUE Sidemount configuration is comprised of:**

- a. GUE base equipment configuration (except Tank/cylinders, Regulators, Backplate, BC)
- b. One primary and two backup lights
- c. Tanks/cylinders: Students are required to use independent cylinders with single valves and without manifolds, which allow for the use of one first stage each. Stage cylinders with proper cylinder marking (2.2, e) will also be utilized.
- d. Regulators: One of the second stages must be on a 7 ft/2 m hose. Both first stages must supply a pressure gauge and provide inflation for a drysuit (where applicable) and a wing.
- e. Sidemount harness: A diver's sidemount setup should be back-mounted and minimalist in nature. Wing size and shape should be appropriate to the cylinder size(s) employed for training.

**Additional Course-Specific Equipment**

- a. Where required, back gas and stage cylinders with proper cylinder marking (2.2, e) will also be utilized in accordance with the GUE General Training Standards, Policies, and Procedures document and configured in line with GUE protocols.

- b. When drysuit inflation systems are applicable, they should be sized appropriately for the environment; small tanks are placed on the left side of the backplate with larger supplies affixed to the diver's left back gas tank.
- c. Underwater lights:
  - i. When required, backup lights should be powered by alkaline batteries (not rechargeable) and stowed on the D-rings at a diver's chest (except when diving sidemount).
  - ii. Backup lights should have a minimal amount of protrusions and a single attachment at the rear.
  - iii. Backup lights should feature a twist-on/off switch for operation
  - iv. The primary light should consist of a rechargeable battery pack and be fitted with a Goodman-style light handle.
  - v. When burn time requirements create the need for an external battery pack, it should reside in a canister mounted on the diver's right hip.
- d. Guideline devices, as required during cave diving activities:
  - i. A primary reel is required for all cave diving and provides a minimalist form factor with a handle designed to support a Goodman or "hands free" handle operation. The primary reel must contain at least 150 ft/45 m of line.
  - ii. A safety spool is required for each diver while cave diving and must contain at least 150 ft/45 m of line.
  - iii. A jump or gap spool is required during Cave 2 diving and must contain at least 75 ft/23 m of line.
- e. Where required, GUE-approved DPV must:
  - i. Be a tow-behind style with adjustable speed and clutch mechanism.
  - ii. Include an attached cord at the back with bolt snap to be clipped on the front crotch strap D-ring.
  - iii. Include a leash attached to the front to be used for towing.