2.7 CCR Cave Diver

Unless otherwise noted, all requirements listed under *2.1 Standards Applying to all NSS-CDS Training Programs* apply to the course.

2.7.1 Purpose

The NSS-CDS CCR Cave Diver course is the closed-circuit equivalent of the Apprentice and full Cave Diver courses combined. Divers using a CCR in an overhead environment should adhere to rules and guidelines to execute dives in a safe manner and develop the skill set to deal with issues within the environment that may arise. This course is designed to develop the physical and mental discipline for cave diving on a CCR.

2.7.2 Limits of Training

The Limits of Training for CCR Cave Diver are largely the same as those for the open-circuit Cave Diver course. Additionally:

A. At any point during a CCR cave dive, divers must have twice the oxygen, diluent, and absorbent to exit the cave.

B. Divers must have no less than 1.5 times the open-circuit bailout gas needed to exit the cave based on a 21.25 L/0.75 ft^3 per minute SAC rate and a 10m/33 ft per minute swim speed.

C. The team member with the least capable CCR (i.e. scrubber duration) sets the limits for the entire team.

D. PO_2 levels must not exceed 1.3 ATA during any portion of the dive, other than decompression. PO_2 levels during decompression must not exceed 1.5 ATA, excepting for an O2 flush at 6 m/20 ft for cell validation at the end of a cave dive.

E. Divers must not remove primary life-support equipment during a dive.

F. Minimum starting bailout gas volume of 3,400 L/120 ft^3. Bailout gas should have redundant first stages, either through use of a twin-cylinder or H-valve configuration.

G. Each diver's open-circuit bailout cylinders should have a minimum of one 2 m/7 ft hose.

H. Open-circuit bailout should not cause divers to exceed a PO_2 of 1.4 ATA, except for decompression gas, which may have a PO_2 of 1.6 ATA.

I. Students will begin each day with a fresh scrubber.

J. CCR Cave Diver training does not qualify divers to use open-circuit equipment in caves.

K. Students wishing to earn qualification for both open-circuit and closed-circuit cave diving may complete the requirements for the NSS-CDS Apprentice Cave Diver program on open-circuit during this course, but must complete the Cave Diver portion of the course on CCR

L. *At no point during training may instructors do anything which prevents students from monitoring PO_2 levels while the student is on the loop.*

2.7.3 Course Duration and Location

A. This course requires a minimum of six days to complete. Students must log at least 600 minutes of bottom time under direct instructor supervision.

B. Training must take place at five or more different sites. Caves with two or more distinct entrances or which have two main lines leading from a single entrance may count as different sites.

C. The requirements for multiple sites do not apply if there are no other sites available within 200 km/75 miles.

2.7.4 Student Prerequisites

In addition to meeting the normal prerequisites for NSS-CDS Apprentice Cave Diver training, students must:

A. Hold Rebreather Diver certification from a widely recognized training organization.

B. Have logged at least 25 dives and 35 hours of bottom time using the same rebreather as they will use during this course.

2.7.5 Instructor Prerequisites

Instructors must be authorized to teach the NSS-CDS CCR Cave Diver course. Additionally, instructors wishing to issue dual qualification for both open-circuit and closed-circuit cave diving must be authorized to teach the open-circuit NSS-CDS Cave Diver program.

2.7.6 Knowledge Development

Students in the CCR Cave Diver course must be able to answer the same questions as students taking the Apprentice and Cave Diver courses. Additional CCR-specific subject matter instructors must cover during this course includes:

A. Rebreather operation

   1. Rule of thirds for oxygen, diluent and scrubber duration.
   2. Calculating oxygen duration based on metabolic need/workload.
   3. PO_2 setpoint selection based on dive duration and oxygen exposure.
   4. Review of Hypoxia, Hyperoxia, and Hypercapnia.

B. Equipment configuration, including:

   1. Bailout configuration options, cylinder selection, and mounting.
   2. Bailout volume calculations and considerations for CCR team and mixed open-circuit team diving

a. Each diver must maintain at least 1.5 times the open-circuit bailout gas needed, based on a 21.25 L/0.75 ft^3 per minute SAC rate and a 10 m/33 ft per minute swim speed.
b. Mixed teams must maintain at least twice the open-circuit bailout needed, or the open-circuit divers must maintain their own sufficient reserve.

3. Offboard plug-ins, selection and options.

C. Complex dive planning:

1. Jumps, circuits, and traverses on a CCR.
2. Spoke diving – multiple penetrations based on a bailout range.
3. Sawtooth Profile Diving – PO_2 and DIL/ O_2 management.
4. Complexities of extended bottom time dives, including:
   a. Decompression stress
   b. Thermal and nutritional stress
   c. Physical fitness
   d. Mental fitness
   e. Primary and backup light burn times.

2.7.7 Land Drills

Instructors must cover the same dry-land exercises as outlined in the Apprentice and Cave Diver course standards with an emphasis on bailing out to open circuit in the event that there is no way to monitor PO_2.

2.7.8 Open Water Drills

These are the same as those outlined in the Apprentice Cave Diver and Cave Diver course standards but with an emphasis on bailing out to open circuit when divers cannot monitor PO_2.

2.7.9 Overhead Environment Exercises

These are the same as those outlined in the Apprentice Cave Diver and Cave Diver course standards but with an emphasis on bailing out to open circuit when divers cannot monitor PO_2. Additionally, students must perform the following CCR-specific skills:

A. SCR Mode, simulating the loss of oxygen, developing breathing rhythms for SCR operation, breathing and flushing. At no time must PO_2drop below 0.5 ATA. This must include exiting:

1. For at least 300 m/1,000 ft at depths exceeding 27 m/90 ft.
2. For at least 450 m/1,485 ft exit at depths shallower than 27 m/90 ft.

B. O/C Bailout, stabilizing the loop, adjusting the set point, and disabling oxygen as needed. Managing buoyancy as necessary. This must include exiting:

1. For at least 225m/750 ft at depths exceeding 27 m/90 ft.
2. For at least 300 m/1,000 ft at depths shallower than 27 m/90 ft.

At no point during training may instructors do anything which prevents students from monitoring PO_2levels while the student is on the loop.

2.8 CCR Cave Diver Upgrade

Unless otherwise noted, all requirements listed under *2.1 Standards Applying to all NSS-CDS Training Programs* apply to the course.

2.8.1 Purpose

This course qualifies students who already possess open-circuit Cave Diver certification.to cave dive using closed-circuit rebreathers (CCRs). This course is designed to develop the physical and mental discipline for cave diving on a CCR.

2.8.2 Limits of Training

The Limits of Training for this course are the same as they are for the CCR Cave Diver course. Additionally, students enter this course already qualified to dive open-circuit equipment in caves. *At no point during training may instructors do anything which prevents students from monitoring PO_2 levels while the student is on the loop*.

2.8.3 Course Duration and Location

A. This course usually takes three days to complete. Students must log at least 300 minutes of bottom time under direct instructor supervision.

B. Training must take place at two or more different sites. Caves with two or more distinct entrances or which have two main lines leading from a single entrance may count as different sites.

C. The requirements for multiple sites do not apply if there are no other sites available within 200 km/75 miles.

2.8.4 Student Prerequisites

A. Students must hold NSS-CDS open-circuit Cave Diver certification, or equivalent.

B. Students must also meet the prerequisites for the CCR Cave Diver course.

2.8.5 Instructor Prerequisites

Instructors must be authorized to teach the NSS-CDS CCR Cave Diver course.

2.8.6 Knowledge Development

A. Instructors must review and ensure student mastery of the academic learning objectives listed for the NSS-CDS Apprentice and Cave Diver courses.

B. Instructors must also cover the additional CCR-related subject matter listed in the CCR Cave Diver course standards.

2.8.7 Land Drills

Instructors must review guideline/reel techniques.

2.8.8 Open Water Drills

Instructors must conduct an open-water evaluation dive prior to any cave dives.

2.8.9 Overhead Environment Exercises

Instructors must cover the CCR-related skills as outlined in the CCR Cave Diver course standards. Additionally, at their discretion, instructors may include any skills from the Apprentice and Cave Diver courses to ensure student mastery of the material.