BOOM SCENARIO

There are multiple boom (BOOM basically means a leak of supply gas) type failure modes. The most obvious is when an O-ring lets go and you hear BOOM and see lots of bubbles, this is an external boom.

There is also an internal boom, which is a leak of oxygen or diluent INTO the loop of the rig. This could be caused by a stuck solenoid, solenoid fittings, stuck ADV or a stuck manual injection button. This is more subtle and could be signified by a change in buoyancy (positive), change in PO2, up if oxygen, down if diluent (which would also cause your solenoid to begin firing to maintain your setpoint causing more buoyancy change. **Any unexpected change in buoyancy while diving a CCR is a cause for concern! Investigate!** A positive change is from a gas leak into the loop, a negative change could be water coming into the loop, pay attention anytime your buoyancy changes for no apparent reason!

There are four possible failures, external, internal, from the O2 supply or the diluent supply. Each are instantly dealt with the same way, but there are multiple ways to end the dive, if you would rather stay on the loop. The divers immediate response to any boom, is to shut down both supply cylinder valves, check your PO2 and check your supply gas pressure gauges. Obviously the most important thing here is to be sure you have a breathable PO2 and if not then correct that problem first. By checking your pressure gauges, you can determine which side of the system is leaking, then turn back on the valve of the side that is still functional (so you don't forget you turned it off, this could be bad).

External Boom

In an external boom, (loud noise, lots of bubbles) you must shut off cylinder valves quick as you can, then check your cylinder gauges, whichever one is losing pressure, is the leaky side. If its diluent, then turn the oxygen valve back on and end your dive, remembering that you may have to inflate your BCD orally at the surface. If you have to descend to get back to the surface, (wreck or cave) you may need to inflate your BCD orally underwater, a difficult skill, or just turn the dil on for a few seconds to power inflate, then back off again. This is the easiest of the four failures to deal with, but not a reason to continue on your merry way. You should finish the dive as soon as you can, and fix the problem on the surface. The culprit could be a leaky hose, extruded O ring, or bypassing over pressure valve on your dil 1st stage.

If your external leak is on the Oxygen side, then your options are more limited. Remember to turn your diluent back on first. You can bailout to OC and surface (easiest and safest) You could also run SCR horizontally back to your surfacing point, then go OC to ascend (or Open loop if you have enough dil to do this) Options are limited if you have deco to do. If you have offboard oxygen, or nitrox, you just plug in and run manual injection. You could also get close to a buddy and plug in their manual O2 supply while they allow the solenoid to maintain their setpoint. (this would require similar fittings as well as practice, to know what the skill would involve before trying it in a real emergency). You may also plumb a rich mix stage cylinder in on your manual injection and breathe that in the loop SCR style. The causes for an external Oxygen leak are the same as for an external diluent leak.

Internal Boom

For an internal oxygen leak, there are two or three possible causes(depends on what CCR you are using and how its plumbed) one a stuck solenoid, two is leaky plumbing to the solenoid and three is a stuck manual add valve. You should be aware of a stuck manual add valve as it will generally stick when you use it, and just keep on flowing gas, the easiest way to take care of this is to disconnect the LPI hose from the manual injection valve and finish the dive just monitoring the solenoid function by listening. The valve will usually pop back out when you disconnect it, but if it doesnt, then you may be allowing water to enter your loop. Cap the fitting if this is the case. (a good reason to have attached rubber caps for your manual add valves) Be sure to Fix the manual add valve before the next dive. (this may sound obvious, but I have seen divers enter the water with a broken CCR.) If you have a stuck solenoid, or leaky plumbing, you must turn off the cylinder valve quickly and monitor your PO2 so you don't spike, flush with diluent if necessary.

You can finish the dive by manually feathering the cylinder valve to add O2, this is also a difficult skill to be good at, especially deep. If you have off board O2, plumb it in manually for better control.

On an internal diluent leak, the only possible cause is a leaky ADV or manual add valve, if it's the manual add valve, just disconnect the fitting, if it's the ADV, shut off the slider valve until you need diluent. If you don't have a sliding shut off valve on your ADV, get one. Otherwise shut down the cylinder valve, remember this may also shut down your BCD inflator.

This is an excellent time to bring up the "all my eggs in one basket" situation. Its a good idea to separate your various diluent supplies and not have everything running off of your onboard diluent. Things like your BCD, drysuit and lift bag could have their own gas supply. APD makes a great little SMB with its own gas supply, there are also excellent setups for drysuit inflation. Why you ask? Let say you were doing a rapid descent into blue water without a wall, or shot line to reference and you had an extruded O ring on your onboard diluent cylinder, so you shut it off. So not only did you shut off your power inflator, but your ADV is now dry, and your drysuit wont inflate and your loop is trying to suck your tongue into your DSV and the only gas you have available to inject is O2. Not the best option really. And you continue to descend…even faster. YIKES! this sucks you think? My suggestion is to separate the supplies. I generally run my BCD and ADV off of the onboard diluent and hook my drysuit to the bailout cylinder that does not have helium in it. I am usually weighted so that I don't have to inflate my BCD much while descending and am only using my drysuit to maintain neutral buoyancy. Obviously this doesn't apply in warmer water. For that situation, always have your stage cylinders plumbed as to be able to manually add gas to your counterlungs, or switch the hose whip to your BCD. Counterlungs can be used for emergency buoyancy! I can also remove the whip from my BCD and hook it to my drysuit if I need to. Its best to have all the same fittings on all inputs, from the BCD inflator, dry suit inflation, off board gas injection and stage cylinders, this way you can mix and match gas to where its needed most. Its a good idea for your whole dive team to follow this also. The only exception to this rule would be those who use argon as a drysuit inflation gas, it would not be good to inject argon into your breathing loop and having a different connector, or tag, or hose colour on this line could prevent a disaster.

To fix sticky manual add valves without disassembly, take the hose off the valve, pack the end of the hose fitting with christolube, re attach the hose and activate the valve, blowing the lube through the valve, repeat until the valve works again. I do this lube procedure once a month or so and my valves don't stick any more. Its still a good idea to have your inflator valves serviced annually.

Some suggestions for Practicing these Skills

Make up a set of flash cards or slates with these situations.
BOOM! The diver should shut down both valves, check PO2 and pressure gauges.
The trainer could then point at one gauge and make the out of air sign, meaning that side is leaking. The diver then turns on the working side and completes what he needs to do to bailout.
The trainer could also (in less than 20fsw of water ONLY) press and hold down the oxygen manual inflator to simulate a stuck solenoid or stuck inflator. The diver does a shutdown, checks PO2, flushes, checks gauges, completes bailout. this could also be done with the manual dil add button. Part of this skill for the diver is to not ascend more than 5 feet/1.5 M while dealing with the problem.
The trainer could also sneak up alongside or under the diver and purge a second stage reg to simulate an external BOOM. This one is always fun.
A diver should be able to reach and shut down both cylinder valves in less than 5 seconds, with practice. I normally only have the valves on 2-3 twists, not the whole way, to facilitate quick shutdowns.

In any of these training scenarios, be sure all gas supplies are turned back on prior to the next skill, or ending training time. Make a note on your training slate to help you remember. Check yourself as well as your buddy. I also suggest doing these skills the first few times on dry land, to lock in the muscle memory and to be able to talk out what you are doing with your buddy.