Wilderness Rope Rescue Safety

By Jeff Randall

Any vertical work includes a certain degree of danger. Falling, severe weather conditions (such as lightening, high winds and flash floods), being injured by equipment failures, and being hit by rocks, equipment or debris are just a few of the dangers a person faces once they decide to practice recreational or rescue vertical skills. Some of these dangers can be nothing more that an inconvenience while other may be life threatening. It is always the responsibility of the rescuer to save themself first. A rescuer working to save a victim that also becomes a victim now requires additional resources for the team to save both the rescuer and original victim.

Safety is as much a mindset as it is a physical application of a skill. Awareness is the first key to working safely. Always be aware of the "what if's" for any situation. As with any rope skill, safety is a chain that's only supported by its weakest link. Awareness of what could happen in the chain of events is a critical aspect to productive, safe work. Egos need to be checked at the door and not come into play once you begin dangerous activities. Any rescuer or recreational rope practitioner who wants to 'cowboy' his way through a scene should be considered a liability to the whole team and operation. Safety should also fall back on your previous experiences in the field. For example, if you see a fellow teammate suffering from exhaustion or dehydration, yet refusing to address his own issues, he should be tended to immediately and not be part of building or participating in a life saving system until he has recovered.

You should also check your own survivability based on worst-case scenarios when it comes to recreational rope work and rope rescue. For example, if you're the rescuer going over the edge to rescue a victim, what happens if the system malfunctions and you're stuck at the base for a while? Do you have enough knowledge and gear to stay put while the team fixes the system? What if your anticipated 8-hour canyoneering trip turns into an overnighter due to unforeseen circumstances? Do you have the gear and ability to stay warm and safe? Enough water to stay hydrated? Spare batteries for your lights? Did you leave detailed information with someone about your trip? While many of us tend to overthink survival scenarios, it's always the simple mistakes that tend to cause the most damage.

Rules Of Safety

Safety rules that should be adhered to any time you are working on or around technical or recreational rope activities:

- Every person should always know their own limitations when it comes to application of skills, as well as their own physical and mental abilities. Never be afraid to admit when something is outside your capability.

- Carry the right gear with you for the task at hand, and try to think of the "what if's" before you commit yourself to a task.

- Carry survival gear on every mission. A jacket, water, fire starter, flashlight and similar survival tools pack up very small and may indeed save your life.

- Be aware of the "good idea fairy". She usually pops her head up when a task is more difficult than the skills or tools you have at your disposal. Any improvisation should be carefully and fully discussed with your team and only implemented when deemed safe.

- Drink plenty of water, eat when you can, rest when you can. These three things will go a long way in keeping you mentally coherent and working at your maximum mental and physical output. They should be standard operating procedure for any discipline.

- Always wear the proper personal protection equipment (PPE) anytime you are work on or around rescue and rope systems. If you see a fellow teammate violating this rule, then don't be afraid to bring it to their attention. Any person may be reminded to don their personal protection equipment - rank or experience level does not apply here.

- Always put on your PPE (personal protection equipment) before you approach the operations area, not at the rescue scene where others are already working. Always have a teammate check your gear after you put it on and before you put it into service. Use the touch system, which means the person checking the gear physically touches each attachment point and checks to see if it's secure. Merely looking at it doesn't work for a true safety check in the same way as quickly looking into a gun's chamber to see if there's a live round in it. Our minds get so use to everything being ok that our eyes will miss the cartridge being in there.

- If you have to remove your gear to use the bathroom or for other reasons, always have a teammate check your equipment when you put it back on.

- Never, ever perform any dangerous activities under the influence of drugs or alcohol, nor allow anyone doing so to be within your work area.

- Always be attached to a personal tether when working near or on elevated environments. No one should be allowed into the work zone that is not attached to a safety line. If there is no

safety tape designating the zone, then never go closer than ten feet of the cliff edge without being tied into a tether. Never attach yourself to a tether that is long enough to fall over the edge.

- Pay attention to all the gear you have on and how it is placed. It's extremely easy for an abundance of hardware and Prusik cords to get tangled, come loose, or go over the edge. If you do drop something or see something fall, immediately yell "Rock!"

- If you are working below the edge and hear someone screaming "rock!", don't look up. Some instructor teach to move out of the drop zone (which is preferred if you have that luxury), but typically there is not enough time to do so, or you have to look up to see where the object is falling to, or the base area is so small that there is no way to safely move out of the drop zone. One good technique is to tuck your body in to create as small of a target as possible, keep your head down and press yourself against the cliff face or wall. If you're a litter tender then use the litter to shield yourself if possible.

- If you are working at the base of a high angle operation stay clear of the drop zone unless it is necessary for you to be in it.

- If you have long hair or loose clothing, tuck it in and secure it before getting on rope. If you work enough on rope you will eventually see hair, a shirt, a glove or some other item get sucked into a descender or piece of gear. It is extremely hard to remove when the line is under tension.

- ALWAYS wear leather rope gloves and an approved helmet and harness when working with rope.

- In a rescue scenario never throw heavy objects (including loaded rope bags) over the edge. It is much better to work gear down the cliff face at an easy pace.

- Always tie a stopper knot in the end of a working rope and leave enough tail (at least four feet) below the knot – you may need it later.

- Never go down a rope without the ability to come back up, whether this is mechanical ascending system such as Frog, Rope Walker, RAD or a set of Prusiks. ALWAYS have a way to self-rescue!

- Always carry a rescue knife. Although we never want to cut an active rope in a rescue, there may be a time when there is no other choice. In fact, we actively train on cutting tensioned ropes in our SRT course. We choose to carry a safety knife or EMT shears for this purpose, rather than a standard folding or fixed blade knife. If you have to cut a victim's rope then you had better

be able to explain the reasons in doing so, which means exhausting all other possibilities to effect the rescue. *You have to be 200 percent sure of the outcome when deploying a knife for rescue!* Loaded ropes cut like hot butter and even with belays and the victim tied to other lifelines, rope cutting may still cause shock loading of the system.

- Avoid shock loading a rope and/or system. Allowing a load to fall even a very short distance then coming to a hard stop puts extreme loads on the system and could cause catastrophic failure.

- In rescue scenarios, always use a belay. No matter how much experience you have, and no matter your skill level, always use a belay when available. If you are using single rope techniques and designated the first man over the edge, then you can choose to use a self-belay technique, such as an autoblock or Prusik below your descender. As a side note, avoid self-belay Prusiks that run above your descender. Tests have shown these to be ineffective in a panic situation.

- Do not panic if something goes wrong. Calm down, think through your situation, allow your past experiences and skills to come into play, then use available resources to rectify the situation. If you haven't already hit the bottom, then most likely you won't if you will calm down and think through the situation.

- Never declare a rescue system is ready to operate until checked off by a designated safety officer.

- No matter your position on the team, you should always be in safety officer mode. Any team member has the right to stop the operation if they see a safety issue. Do NOT be afraid to speak up, regardless of your skill level. Always remember that your role as a Technical Rescue Professional is to always be looking at potential hazards and working to mitigate them.

- Always have a safety briefing before operations begin. Even if the operation is a recreational activity, make sure all team members know what to do if an emergency pops up.

- Regardless of the rescue scenario, THERE IS ALWAYS TIME FOR SAFETY! Remember, the responsibility of the team and your own safety comes before anything else.

Safety Factors

Safety factor is the minimum breaking strength (MBS) divided by the maximum force expected to be applied. For example, if you have a carabiner rated for 5,000 lbf (22.2 kN) MBS

and you suspend a 1000-pound load from it, then your safety factor would be 5:1. If you suspend a 5000-pound load, then that factor would decrease to 1:1. At a 1:1 factor the component would be considered having no margin of safety. Any further loading could cause failure. It should also be noted that how a piece of equipment is being used will affect the MBS it is rated at. A knot tied in a rope decreases its MBS considerably. Side loading, tri-axial loading or torque loading a carabiner lowers its minimum breaking strength.

A rope system should be thought of as a chain that will break at its weakest link. Loads and stresses will be different on each component depending on where it sits in the chain. Each link has to be analyzed for its safety factor in relation to the job it's performing. This is known as a Static System Safety Factor (SSSF). Most rescue teams seek to achieve a 15:1 SSSF even though there is no standard stating what that factor *must* be. NFPA 1983 (standard for manufacturers) stated that a lifeline's strength is to be 15 times greater than the load applied to it, so most teams took that standard and applied it to the whole system. This was never the intent of the standard. In fact, the ratios in the standard are different depending on the specific group of equipment being detailed.

The second factor to be considered in a rope rescue system is the Dynamic Systems Safety Factor (DSSF). Since rope rescue systems move, the forces applied to them will change from static (sitting still) to dynamic forces. These forces can be much higher on the system due to haul teams pulling on mechanical advantage systems and/or uncontrolled shock loading. DSSF is much harder to calculate than SSSF simply because of the variable factors involved. For example, how smooth a haul/lower team operates the system will directly effect how much dynamic force gets applied to the system as the load is raised or lowered. Another example would be having too much slack in a belay line should a mainline or change of direction failure occur. In general, the longer the fall, the greater the force (shock load) applied to the system. The higher the SSSF is, the more safety you will have in a system to safely control dynamic forces.

So, what should the SSSF be? Since there is no direct standard, this is something that has to be determined at the team level's SOP as to what is acceptable. Naturally, you want that factor to be as high as possible but this typically means heavier gear, which, in many cases has to be ground-pounded in for miles through rough terrain. Fire departments typically seek to achieve the 15:1 factor while lightweight mountain rescue teams will decrease that considerably due to their area of operations.

For most rescue scenarios a two-rope system is used. A mainline does all the work raising or lowering and a separate belay line acts only as a backup to a mainline failure. Anchors and other pieces in the system can be backed up the same way, but redundancy to the point that it requires too much time and gear may be self-defeating in a rescue. Backups should be a balancing act between safety, efficiency, type of rescue, location of rescue, and the amount of gear required. Just remember that given a choice, always tip the scale towards the safety side.

While most technical rescue teams always use a two-rope system, SRT (Single Rope Technique) rescues are widely accepted in some areas of rope work. Cavers, for example, may use a single rope counter-balance haul to extract an injured party out of a pit or slot. Specific two-rope systems can also cause problems in some cases: A Stokes basket rigged on a highline using a reeve to lower and raise in 'free air' in a pit or slot canyon may start spinning due to air flow out of the pit or canyon. The resulting twist in the two ropes now becomes a huge hazard and obstacle for the rescuers to overcome. Many teams will overcome this by adding a control line to the head or foot of the basket, or simply use a single line for lowering/raising the Stokes instead of a Norwegian or English Reeve.

Whatever techniques and safety factors your team uses, system integrity has to be maintained 100-percent of the time, regardless of how many unforeseen issues pop up. All it takes is one critical link to fail to create a disaster. This integrity is not only achieved by using the proper equipment and techniques, but through pre-planning and scene size-up.

Preplanning / Scene Size-Up

Having your rescue gear organized, pre-staged and labeled for contents and rope lengths saves a lot of time and also decreases the chance of sub-par substitutions once you're on the scene. Regular training sessions with your team are a must! Too many times a rescuer attends a class and gets "certified" then never uses the skills again until that once-in-every-two-year high angle rescue assistance call goes out. To stay on top of their game in technical rope rescue skills, a team should have monthly training sessions that rotate between all the skills required in NFPA 1006. As is stands now, time frames between initial certification and recertification are too long to consider yourself competent and efficient during the interim. Never stop training!

In the real world some of the best rescuers are not NFPA 1006 certified, instead their passion and skills come from using rope skills for rappelling, caving and exploring. Doing this as a regular recreational hobby affords them a lot of experience in problem solving, understanding what works, knots, anchors, equipment uses, varying terrain and what dangers may exist on a particular scene. These rope enthusiasts transition to rope rescue scenes very well and are usually very efficient at the craft. Volunteer rescue teams who have a passion for both rescue and recreational rope work will always be researching, training and trying new techniques. Seek them out and use them on your team of they qualify.

Experience in the environment is also a huge asset to safe rescue practices. For example, a rescuer from the southeastern United States understands the soil types, rock makeup and vegetation that can be used for anchor systems. Move that same rescuer to an unfamiliar arid desert climate and system construction may well change due to soil and rock composition, and the

depth of the vegetation's root system. Again, seasoned outdoorsmen with a passion for vertical recreation seem to transition well to rope rescue technicians. Not only do they know how to navigate the particular terrain, but they typically have enough experience to know what unseen hazards there may be. Learning rope techniques are fairly easy and proficiency can be increased with practice, but having the experience to think through the "what if's" comes solely from hard won experience, and that may well be the difference between life and death.

Safety Officer / Safety Checks

Designate a safety officer. This person is not part of rigging or operation. His only job is to make sure that the system and individuals are safe before operations begin, during operations and during site cleanup. Naturally the safety officer has to be very experienced in all aspects of rope rescue but he's the one guy that doesn't get his hands dirty. The reason for this is if the safety officer actively gets involved in correcting or teaching a technician how to do something, then it takes his mind away from the overall picture. The team leader is responsible for operations and delegating tasks at the scene, but the safety officer has the right to stop all operations and override the team leader's authority to resume operations until changes are made and the system is safe. The safety officer will always check the system and then notify the team leader it is safe to begin (or resume) operations.

The safety officer is also an important part of the scene planning before anchors are set, life lines are installed and systems built. The team leader and safety officer will survey the site, find appropriate fall lines (route of the ropes over the edge), potential anchors, identify obstacles and hazards and create a plan of action for the rescue to commence. All of these will be discussed with the whole team during the pre-operation briefing.

Safety Check

- Double check all rescuers' PPE before the operation begins. This is usually a visual scan since the touch system has already been employed. During this scan the safety officer is verifying that helmets are secure, and gloves and harnesses are on. He's also looking to see if there is a hazard such as an un-tucked shirt or Prusik dangling dangerously from his gear load.
- Verify the system is built properly. For example, are load release hitches in place and is the system ready to do a changeover if required.
- Verify edge protection.
- Verify all carabiners are lock and properly oriented.
- Verify Prusiks (if using them for progress capture and belays) are properly tied and placed on the lifelines.

- Check for rope and cordage damage.
- Check for hardware damage.
- Verify with the team what everyone's job is.

Once all of the above has been completed the safety officer can advise the team leader that operations are ready to commence. Once operations have started the safety officer will closely observe the operation and watch for coming problems, such as a knot about to pass through the lowering or raising system, rope getting tangled, belays being properly managed, carabiners side loading, etc.