SECTION 5. ROPE ACCESS

INTRODUCTION

Rope Access: name of the techniques employees use while in suspension where ropes are used as the primary method to gain access to a location.

NOTE: **Employees who use this type procedure to perform work must receive training before initial use. Annual refresher training is mandatory per regulatory requirements.**

Benefits of Rope Access

- Easy to access multiple locations quickly while working on towers or tall structures.
- Easy to travel around while working on odd shaped structures or structures without platforms.
- No need to be holding on with one hand and working with the other, you can use both hands for working while in suspension.

USE OF ROPE ACCESS EQUIPMENT

A. **Scope and Application.** This section establishes safety requirements for rope access and the use, care and maintenance of rope access equipment as defined in Title 8, Section 3207, of Cal/OSHA safety regulations. Rope supported work shall be permitted only when other means of access are not feasible or would increase the risk of injury to the employee and/or the public. The requirements of this section include, but are not limited to, the inspection of dams and spillways, access to interior or exterior structural and architectural components of buildings, highway/bridge inspection and maintenance, and access to powerplant penstocks.

EXCEPTION: (1) Window cleaning and exterior building maintenance as regulated by Articles 5 and 6 of these Orders; (2) Emergency search and rescue operations; (3) Entertainment performances and rehearsals.

B. **Approval.** Rope access equipment shall be approved for its intended use as defined in Title 8, Section 3206, of Cal/OSHA safety regulations.

C. **Training.**

(1. The employer shall establish, implement and maintain a written Code of Safe Practices for rope access work. The written Code of Safe Practices shall include, but not be limited to the following elements:

a. Methods of rope access and anchorage used by the employer.
b. Employee selection criteria.
c. Equipment selection and inspection criteria.
d. Roles and responsibilities of rope access team members.
e. Communication systems.
f. Employee training program.
g. Rescue and emergency protocol.
h. Identification of any unique site hazards that may affect the safety of employees using rope access methods.

(2. Employees shall be trained in accordance with the Code of Safe Practices, including rescue techniques. The employer shall evaluate the competence of the employee to perform rope access in accordance with the Code of Safe Practices including a hands-on demonstration by the employee of his/her rope access skills.

(3. Employees who perform rope access shall receive annual refresher training. The training shall include a reevaluation (e.g., hands-on demonstration) of the employee's ability to perform rope access in accordance with the Code of Safe Practices.

(4. Documentation of employee training shall be maintained as required by Section 3203 of these Orders.

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D. Equipment Inspection and Maintenance.

(1. The manufacturer's recommendations for use, care, inspection and maintenance of rope access equipment shall be followed.

(2. A qualified person shall inspect rope access equipment each day before and after use to determine that the equipment is safe for its intended use.

(3. Damaged or defective rope access equipment shall be immediately removed from service.

E. Anchorage. Anchorages shall be sufficient to safety support at least twice the maximum anticipated dynamic load imposed upon them as determined by a qualified person.

F. Personal Protective Equipment. Employees performing rope access work shall be provided personal protective equipment in accordance with Article 10 of these Orders.

G. There shall be at least two trained employees present when rope access equipment and techniques are used.

H. Trainer Qualifications. Employees who use rope access equipment and/or perform rope access shall be trained by persons with the qualifications and experience necessary to effectively instruct the employee in the proper fundamentals of rope access, equipment, and techniques as described in subsection (c) of this section.

I. The employer shall provide for the prompt rescue of employees in case of equipment malfunction or a fall, or shall assure that employees are able to rescue themselves.

J. A safety, secondary, belay, or backup line, or other appropriate fall arrest device shall be used when the main line is the primary means of support, unless the employer can demonstrate that the second line or other fall arrest device would create a greater hazard or would otherwise be infeasible.

(1. When a safety line is used in conjunction with the main line, each line shall be provided with a separate anchor, and shall be separately fixed to the employee's harness. This shall not prohibit both lines from being attached to a single harness attachment point.

K. Precautions (e.g., barricades, warning lines) shall be taken to control vehicular traffic and/or prevent unauthorized persons from walking or working beneath employees performing rope access operations.

(1. The employer shall conduct a pre-rope access briefing to discuss the objective(s) of the rope access work to be performed, any unusual site-specific hazards or environmental conditions that could affect the safety of the employee, and emergency procedures to be followed (e.g., employee rescue).

5.1 HVA/HVL TANGENT TOWER INTERNAL CROSS GUY MAINTENANCE

5.1.A SCOPE

Suspending an employee on rope not supported by guys:

This section contains information pertaining to suspending a tower maintenance employee from a two rope systems on either side of an HVA tangent tower for the purpose of accessing the intersecting cross guys for maintenance reasons.

The two sides are called

1. **Main lifting/lowering** side, (raises and lowers the employee), and
2. **Deflection side,** which positions the suspended employee left and right (looking at the transverse face of the tower) directly in line with the intersecting cross guys.

Therefore, two tower climbers will be needed for this operation each of which will perform the tower rigging and later belay the suspended employee from each side.

Both independent systems will be managed on the ground by ground crews using mechanical advantage (pulley systems) and lowering systems (friction appliances).

These 2 rope access systems are required to keep the weight of the employee off the intersecting cross guys so as to not negatively influence the retensioning of these guys by the ground crews (in contrast to the HVD down guy maintenance procedure). The suspended employee will be removing the cross guy intersecting pre-form temporarily so that retensioning of each of the guys can be made by the ground crews. Once this tightening has occurred, the suspended employee can then reinstall the old cross guy intersecting pre-form, or replace it.

At no time during this work is the suspended employee, nor any of their rope system above the intersection of these guys, therefore will not be in proximity to any energized conductor of the middle phase above.

NOTE: **This procedure can also be used on the cross guys of the HVD dead end towers.**

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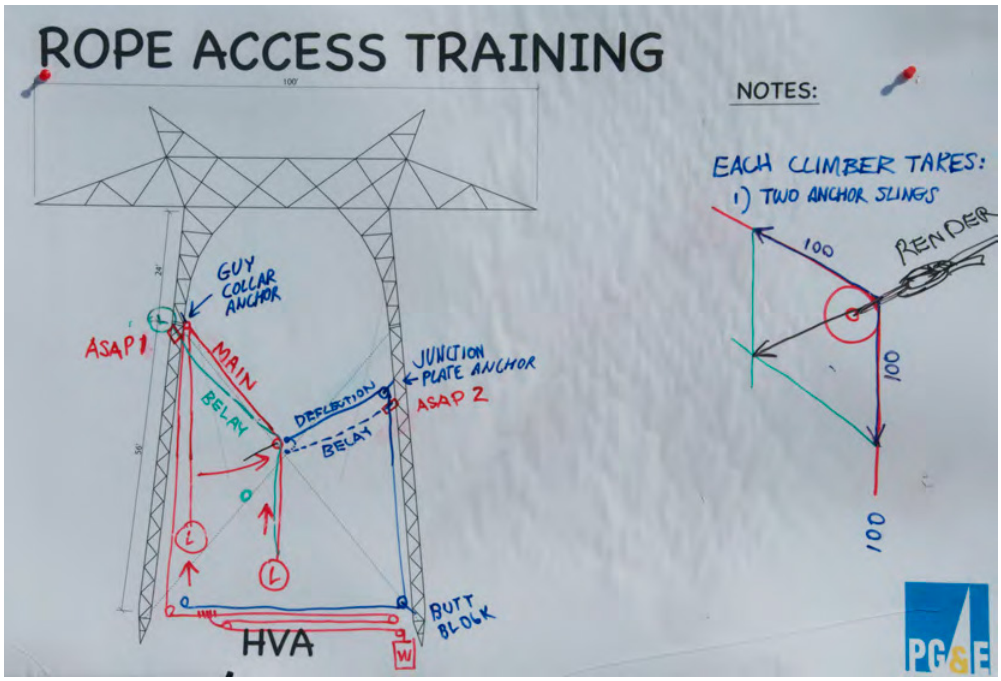

Figure 5.1.A.1. Example of field drawing created during the crew's tailboard during one week training session in 2014..

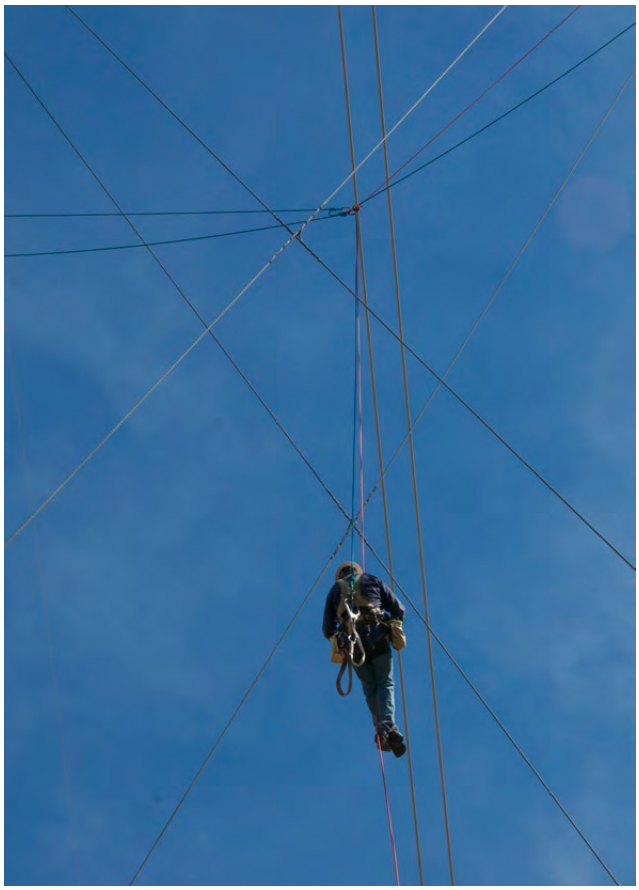

Figure 5.1.A.2. Employee being lifted by rope access system towards HVL cross ties above.

5.1.B ROPE AND GEAR REQUIREMENTS

This work will require specific rope and equipment in order to be able to comply with CAL OSHA §3270.1. Use of Rope Access Equipment.

1. Approved Tower Access Harness for suspended employee
2. Petzl Helmet for suspended employee
3. Petzl Podium work seat for suspended employee (recommended)
4. Fox 40 whistle for suspended employee (tether to helmet strap) (recommended)
5. 1 ea. 250′ 7/16″ diameter any color (main)
6. 1 ea. 250′ 7/16″ diameter different color (deflection)
7. 1 ea. 125′ 7/16″ diameter different color (belay)
8. 1 ea. 125′ 7/16″ diameter different color (tag)
9. 2 ea. Metolius Express 2380 cu. in. (39 L) haul sack (for 250′ rope storage and deployment on towers)
10. 2 ea. Metolius Mescalito 1450 cu. in. (24 L) haul sack (for 125′ rope storage and deployment on towers)
11. 3 ea. CMC Rescue MPD® for 7/16″ rope
12. 10 ea. 24″ anchor strap
13. 8 ea. CMC Rescue 24″ AZ Bound Loop Prusik loops (short), red color
14. 12 aluminum auto locking carabiners, 29 kN minimum breaking strength
15. 8 ea. Rock Exotica 2″ single sheave Omni Blocks®
16. 2 ea. Rock Exotica 1.5″ double sheave Omni Blocks®
17. 3 ea. Petzl ASAP® Lock with integral shock lanyard
18. 1 ea. Skyhook® life-rated Standard capstan winch including:
    a. Skyhook® Pelican weatherproof case
    b. Skyhook® winch bed quick straps (red, 2″ wide)
    c. Skyhook® 2″ trailer hitch adapter mount for winch (not in case)
    d. Makita 110v power drill adapted for Skyhook®
    e. Skyhook® hand crank

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5.1.2 PREPARATION

5.1.2.A TAILBOARD

A proper tail board must occur with all crew members attending:

- Hazards associated with the rope access work, including hazards below the work area.
- Discussion of what each person on the rope access team is responsible for.
- Main and belay line and separated anchorages.
- Status of the line being worked on – are there clearances needed?
- Discussion of the Code of Safe Practices for rope access work.
- Method of communicating with elevated employee in a noisy environment (including the generator and capstan drill).
- Potential rescue of employee from elevation. Rescue plan.

Figure 5.1.2.A. Tailboard discussion.

5.1.2.B COMMAND STRUCTURE

- A command structure needs to be in place for the work method.
- The person on the crew who is in charge is referred to as the Controller.
- The Controller is the person in charge who "controls", or commands the rope access operation.
- Each employee's role on the team should be understood before work begins.
- Use a concise, LOUD means of communication, since the suspended employee and both climbers on either leg are elevated, and the ground crew is far below.

Figure 5.1.2.B. The Controller stands apart with a good view of the transverse face of the tower.

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5.1.2.C VEGETATION/GROUND PREPARATION

- All intervening growth below the power line which can negatively effect the roped operation should be removed before the work begins.
- Clean ground tarpaulins can and should be used to keep dirt and sand off of the ropes and hardware that the rope passes through.

⚠WARNING

Dirty rope will be detrimental to your hardware like the MPD® or pulleys.

Figure 5.1.2.C. Plant growth below the power line can negatively affect the operation.

5.1.2.D TENSIONING OF EXISTING GUYS

- Provision for tensioning up the HVA guy lines after the suspended employee removes the pre-form cross ties should be addressed early so as to not cause delay in getting the employee to the ground.
- Provision for tensioning should take place before the employee leaves the ground if possible.

5.1.2.E GEAR INVENTORY/INSPECTION

Before the work commences, all gear and rope should be inventoried.

A visual inspection of the rope and gear by a competent person should take place before work begins.

Figure 5.1.2.E. Gear inventory and inspection by employees prior to work.

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5.1.3 DISTRIBUTE ROPES FOR HVA/HVL TOWER ROPE ACCESS WORK

5.1.3.A PRIOR TO EMPLOYEE SUSPENSION BY ROPE SYSTEM

Distribute ropes for HVA/HVL tower rope access work:

1. Ropes can be laid on clean ground tarpaulins between:
   a. the HVA tower legs
   b. the HVL tower legs (same side) of a self supporting tower
   c. between one tower leg and a vehicle.
2. If vehicle is used, keys should be taken out of the ignition and assigned to the supervisor. Wheels should be blocked against the direction of pull. Brake should be set.

⚠WARNING

Make certain that the vehicle is secure and cannot roll or be moved before using it as an anchor for human loads.

Figure 5.1.3.A. Making up the defection side rigging.
Clean Tarpaulins will be used to protect equipment. .

5.1.3.B MAKE UP DEFLECTION SIDE RIGGING (MAIN AND BELAY)

Make up deflection side rigging (main and belay):

1. Use the 250′ long rope for the deflection side and temporarily anchor the top end of that rope found in the bag to the base of the tower leg.
2. The person making up this "deflection yoke" should have 2 carabiners, 1 single sheave Omni Block® pulley, and 1 double sheave Omni Block® pulley.
3. Clip a single sheave Omni Block® to the rope below this temporary anchorage between the anchorage and the bag of rope. This will make pulling the rope out easier. Later, this block will be used as the top deflection line "armpit block" below the internal cross guy collar on the HVA tower.

Figure 5.1.3.B.1. The deflection yoke made up with a blue rope on the right. Each knot is a figure of eight on a bight about 8" apart with a slack rope "jumper" in between each knot.

NOTE: **The belay line figure of eight knot is on top with the carabiner. The double Omni Block® is lower. The red and blue ropes to the left are the main lifting/lowering line (red) and the belay for that side (blue).**

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4. Pull the single sheave Omni Block® towards the opposite leg of the tower. Allow the rope to run out of the bag freely.
5. When you arrive at the other opposite tower leg, stop, and allow the Omni Block® to go limp and roll it back towards the bag of rope, and not towards the anchored end of the rope.
   a. With this block now out of the way, construct the deflection yoke by tying two figure of eights on a bight knots about 8″ apart from one another in the rope.
   b. Attach one carabiner to each knot. The single Omni Block® should still be on the rope between these knots and the bag of 250′ rope.
6. There are now two segments of rope from the deflection yoke back to the bag and temporary anchorage on the tower leg:
   a. The segment from one of the knots to the temporary anchorage on the tower leg will be the future belay line for the deflection line.
   b. The segment from the remaining knot back to the bag on the ground with the balance of the rope will be the actual deflection line. Attach the double sheave Omni Block® to the carabiner on this knot. It is important that the double sheave Omni Block® not be put on the other knot.

Figure 5.1.3.B.2. Deflection yoke fully rendered.

7. Lay this double knot deflection yoke with double sheave Omni Block® on the tarpaulin at the center of the tower roughly under the intersecting guys above. Adjustments can be made accurately later when a load is applied.
8. Walk back to the bag of rope at the tower leg taking the unused dormant future armpit block with you. This block will be taken up the tower by the deflection side climber.
9. Ground crew can now construct lifting/lowering rigging on ground in preparation for the deflection line.

5.1.3.C DEFLECT SIDE CLIMBER RESPONSIBILITIES

Deflection side climber responsibilities:

1. The deflection side climber will take the following up the tower leg:
   a. 2 anchors straps
   b. Carabiners (2 or more)
   c. End of 250′ deflection line rope temporarily tied to tower leg
   d. The deflection armpit block mentioned earlier.
2. Untie the end of 250′ rope from tower leg and tie a double overhand stopper knot in the end if one does not exist.
3. Attach a Petzl ASAP® Lock with integral shock absorbing lanyard. The engraved "UP" arrow on the ASAP® should be pointing at the double sheave Omni Block®, and away from the double overhand stopper knot.

⚠ WARNING

The ASAP® must be placed on the rope correctly to work properly as a belay for the deflection.

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Figure 5.1.3.C.1. Deflection line side climber stops before ascending HVL leg to untwist ropes, as ground crew assists.

Figure 5.1.3.C.2. Deflection side climber on right ascending HVL tower with Petzl ASAP® and shock absorbing lanyard on end of belay rope, and also bight of deflection rope.

Figure 5.1.3.C.3. Deflection line side climber (right) stops below guy collar to place both anchors for the deflection belay and deflection line.

Figure 5.1.3.C.4. The Petzl ASAP® LOCK with corresponding shock absorbing lanyard placed on a 7/16" rope.

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Figure 5.1.3.C.5. The Petzl ASAP® LOCK showing "UP" arrow, and also the "Lock" button on the side of the cam.

⚠WARNING

The climber must be careful not to twist the ropes as he climbs the tower leg.

- The single sheave Omni Block® (future armpit block on the tower leg above) which is on top of the bag can now be clipped to the gear loop of the climbers harness with a carabiner. As they climb, the rope will freely feed out of the bag which remains on the ground. A ground crew member may have to hold the deflection yoke to keep it from being pulled away.
- The Petzl ASAP® Lock and shock absorbing lanyard can also be clipped to the climbers gear loop with a second carabiner.

NOTE: **Careful not to twist these ropes. It will be difficult to correct at elevation.**

- This climber will climb to a position well below the guy collar, but never beyond it for any reason as this will put them too close to the energized phases.

Figure 5.1.3.C.7. The deflection line on right side is set at the correct distance to bring up the guy employee just at the cross tie location. Deflection belay is still slack and climber is getting ready to pull up all slack and make up the balance of the belay line so it does not blow into the steel and entangle.

⚠WARNING

The deflection side climber should never climb past the internal cross guy collars on the HVA tower. Stay lower by about 5 to 15 feet depending on the angle of the guys. (See photo)

- The climber will establish 2 anchors one higher than the other by a small distance (no more than 3 feet) with the two anchor straps they have brought along. The top-most anchor should receive the Petzl ASAP® Lock and shock absorbing lanyard with the deflection belay rope still in it. The bottom can receive the armpit Omni Block® with deflection rope still in it.

⚠WARNING

Be careful to not drop the armpit Omni Block® as it is unclipped from the harness. It will be heavy with the rope hanging in a bight from it.

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- Once the armpit Omni Block® is set, the climber can call down to the controller and ground crew to begin rigging the rope out of the bag into the MPD® and subsequently pulling up of all the unwanted slack (but not tight).

Figure 5.1.3.C.8. The deflection line armpit block on right side is set and the climber is now working on setting the belay line anchor. The belay line is still hanging below with lots of slack in it.

- Care must be taken by the climber to not twist any of the ropes. The ground crew may assist the climber in this task and work together in untwisting any ropes. If the climber left the ground with no twists, there should not be any issues later as he reaches his top position on the tower leg.
- As your controller calls for taking up of all slack in preparation of lifting the employee the climber may position themselves at the ASAP® with hands on the "free end" of the rope ready to pull rope upward through this device. The free end is the part of the rope coming out of the Petzl ASAP® Lock in the opposite direction from the "UP" and arrow on the gold face plate of the device. The free end has the stopper knot.
- Just prior to the lifting operation by the main lifting/lowering, the deflection line may be set and tied off in the position which suspends the employee at the guy intersection. This may require a full loading of the rope suspending the employee a

few inches off the ground. Adjustment of the deflection (in or out) is normally done at this time. Once this is accomplished and the deflection line is set and tied off, the climber on the deflection side may pull up all slack and physically lock the Petzl ASAP® (using the "LOCK" button) thus securing the belay line in that position.

- There may be considerable rope involved in the free end of the belay rope coming out of the rear of the ASAP® towards the stopper knot. This rope can be coiled and made up so it does not blow and become entangled in the tower below but in no way secured to the tower leg. It should be left made up and hanging from the rear of the ASAP®. Securing it to the tower will defeat the shock absorbing capability of the Absorbica® shock absorbing lanyard on the ASAP®.

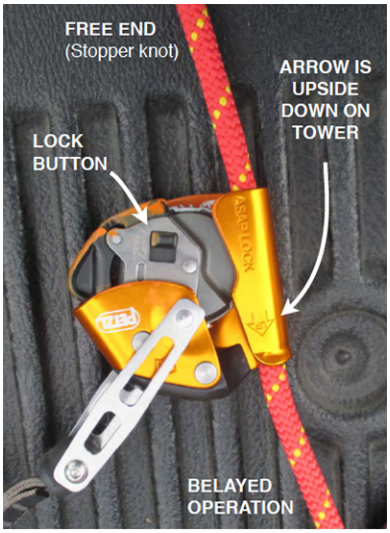

Figure 5.1.3.C.9. The Petzl ASAP® LOCK is shown here. The "UP" arrow on the device should be pointing away from the free end where the double overhand stopper knot is tied.

NOTE: **When the ASAP® is hanging in the tower rendering downward towards the belayed operation (whether the deflection line or the main lifting lowering line) the "UP" arrow will actually be upside down, or, pointing downward. This usually causes much confusion with the climber on the tower legs as it seems that the rigging is incorrect, when it in fact is not.**

⚠ WARNING

Do not make up the balance of the belay rope coming out of the rear of the ASAP® and secure it to the tower. Securing it to the tower will defeat the shock absorbing capability of the shock absorbing lanyard on the ASAP®.

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- At the point where the employee is suspended and being lifted, the deflection line side climber is finished with his tasks and awaits a lowering of the employee and subsequent tear down. The belay for the deflection become automatic by locking the Petzl ASAP®.

5.1.3.D DEFLECT GROUND CREW

Deflection side ground crew responsibilities:

- As the climber takes the armpit Omni Block® and end of rope with ASAP® belay up the tower leg, the ground crew can begin making preparations for the deflection line lifting/lowering.
- A "butt block" at the base of the tower leg will need to be established. Place an anchor strap at the base with a single sheave Omni Block®. Clip the rope coming out of the bag to this block. This can be done as the climber makes their way up the leg as it will not interfere..
- This butt block will need to "render" on the anchor strap and have a clear path to the armpit block above that the climber will establish soon. The rope cannot rub on the steel of the tower at any location.

⚠WARNING

All ropes must be free of the steel of the tower. Adjust rigging and blocks so ropes do not rub or abrade. Any rope that does inadvertently rub must be padded with a rope protector.

- A pulley system "throw" of between 10 feet and 30 feet is required for this task between the established butt block and the pulley system progress capture device (PCD). The CMC Rescue MPD® will be the progress capture device for the pulley system the ground crew will construct.

Figure 5.1.3.D.1 & 2. The ground crew has now established the MPD® progress capture on opposite leg of this HVL tower. The MPD® should hold tension as shown if correctly loaded. Rope should be blue.

- A 3:1 (called a "Z-rig") is generally enough mechanical advantage for the deflection line work as there is not much lifting on this line. Besides the MPD®, its anchorage and carabiner, you will need one prusik rope grab and one additional carabiner to construct the simple Z-rig.

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- With the butt block positioned typically at the base of the tower, the use of a company vehicle becomes a logical choice for the PCD anchor (CMC Rescue MPD® location) as the vehicle can be moved to provide the appropriate pulley system throw.
- The opposite leg of the tower on the HVA is also a logical choice for the throw of a pulley system to be located. However, be mindful that the main lifting/lowering side may also desire that location for their pulley system so there may be some undesired overlap in the rigging there. However, if this area is covered with clean tarpaulins as discussed earlier, this may be the best way to keep your ropes clean.
- On the self supporting HVL towers (see photo) the base of the tower is wider which yields the perfect location for a short pulley system throw. Again, this area will need to be covered with ground tarpaulins.
- With the deflection side 250' rope bag in hand, walk the rope to the PCD/ MPD® location.

Figure 5.1.3.D.3. The ground crew has now established the butt block (foreground) and MPD® progress capture on opposite leg of this HVL tower. They have built a simple 3:1 Z-rig pulley system for moving the deflection line.

- After the climber has reached their position above and established the armpit block on an anchor, load the CMC Rescue MPD® properly as shown. Close the MPD® face plate and use a carabiner to attach the device to its anchorage (secured vehicle, tower leg or other). Check the loading of the MPD® by briskly jerking the rope coming out of the device. It should lock up and give a clicking sound if done properly.

⚠WARNING

Do not load the MPD® until the climber has reached their position on the tower leg above and anchored the armpit block.

- Slack in the deflection line may be taken up by pulling on the "free end" of the rope coming out of the MPD®. The free end is the portion coming from the MPD® to the rope bag. Do not pull ropes up tight until the operation of lifting the employee is imminent. Leave ropes loose for now.
- Be ready to construct a pulley system (3:1, 5:1 or 7:1) by having on hand the needed Omni Blocks®, carabiners and prusik loops.

⚠WARNING

It is mandatory to have members of the ground crew check all rigging on the ground before the lifting operation takes place. Look for twisted rigging or anchor straps, open Omni Block®s or carabiners and rope that may rub on steel, obstructions or vegetation. Early correction before ropes are loaded is easier.

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Figure 5.1.3.D.4. Deflection ground crew waiting for orders to take up all slack through system.

Figure 5.1.3.D.5. In this photo, you can see the armpit block on the deflection line has “rendered” out away from the tower leg so the rope dues not rub on any steel.

5.1.3.E MAKE UP MAIN

Make up main lifting/lowering side rigging (main and belay):

- Once again, all ropes are different colors so that ease of identifying a particular system will be easier.
- Use the 250′ long rope for the main lifting/lowering line and tie a figure of eight on a bight knot in the top end.
- Use the 125′ long rope for the belay line (on the main line side) and tie a figure of eight on a bight knot in the top end.

Figure 5.1.3.E. Here, a ground crew member attaches both the main (red) and belay (far left blue) to the deflection yoke (for right blues). Note no twisting at the double Omni Block® and the red safety back up carabiner is on top.

- Bring both bags of 250′ and 125′ rope to the center of the tower where the deflection yoke is now located.
- In between the deflection yoke (figure of eight knots) and the 2 bags of rope, clip both ropes into the double sheave Omni Block® being sure not to get the ropes opposed in the block. Both figure of eights knots should close to one another.

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⚠WARNING

Be mindful not to twist the double rope pairs in the defection side and/ or main lifting/lowering side when clipping into the double sheave Omni Block® at the deflection yoke. Lay everything out with no twists, then clip.

- Take both of the rope bags to the opposite leg from the deflection line side.
- For the main lifting/lowering side armpit block attach a single sheave Omni Block® back on the rope coming out of the 250′ bag. This block will be taken up the tower by the main lifting/lowering side climber.

5.1.3.F MAIN SIDE CLIMBER

Main lifting/lowering side climber responsibilities:

- Two bags of rope, one 250′ and the other 125′ should be waiting at the base of the opposite leg of the tower from the deflection side. The 250′ is the main line which does the lifting/lowering of the suspended employee. It stays on the ground in the same way that the 250′ deflection line bag does.
- The 125′ rope in a bag is the belay line. Pull the belay rope out of the top of the bag and stack it on the tarpaulin near the tower leg. Once you have the end which was at the bottom of the bag, tie a double overhand stopper knot near the end. Attach the Petzl ASAP® Lock with the shock absorbing lanyard.

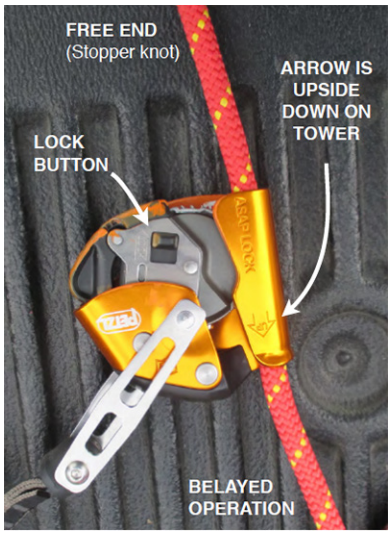

Figure 5.1.3.F.1. The Petzl ASAP® LOCK is shown here. The “UP” arrow on the device should be pointing away from the free end where the double overhand stopper knot is tied.

- The engraved "UP" arrow on the ASAP® should be pointing at the double sheave Omni Block®, and away from the double overhand stopper knot.

NOTE: **When the ASAP® is hanging in the tower rendering downward towards the belayed operation (whether the deflection line or the main lifting lowering line) the "UP" arrow will actually be upside down, or, pointing downward. This usually causes much confusion with the climber on the tower legs as it seems that the rigging is incorrect, when it in fact is not.**

⚠ WARNING

The ASAP® must be placed on the rope correctly to work properly as a belay for the deflection.

- The bag has been emptied of all belay rope and carried empty by the climber to the top position just below the guy collar. There the empty bag will be used to re-stuff the belay line.
- The single sheave Omni Block® (future armpit block on the tower leg above) which is on top of the bag can now be clipped to the gear loop of the climbers harness with a carabiner. As they climb, the rope will freely feed out of the bag which remains on the ground.
- The Petzl ASAP® Lock with the shock absorbing lanyard can also be clipped to the climbers gear loop with a second carabiner. Careful not to twist these ropes. It will be difficult to correct at elevation.

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Figure 5.1.3.F.2. Left side of this tower is the main lifting/lowering line and the right side is the deflection line side. Note the position of each station below the guy collar.

- This climber will climb to a position well below the guy collar but never beyond it for any reason as this will put them too close to the energized phases.

Figure 5.1.3.F. 3. A 3:1 Z-rig with the MRD® as a progress capture device. Also a 3 wrap prusik hitch, Omni Block® and carabiner are required. Above shows a short "throw".

Figure 5.1.3.F. 4. The same pulley system stretched out with a longer throw. Notice no ropes are twisted within the pulley system.

⚠ WARNING

The deflection side climber should never climb past the internal cross guy collars on the HVA tower. Stay lower by about 5 to 15 feet depending on the angle of the guys. (See photo.)

- The climber will establish 2 anchors one higher than the other by a small distance (no more than 3 feet) with the two anchor straps they have brought along. The top-most anchor should receive the Petzl ASAP® Lock with the shock absorbing lanyard with the deflection belay rope still in it. The bottom anchor can receive the armpit Omni Block® with main lifting/lowering rope still in it (same arrangement on the deflection side).

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Figure 5.1.3.F.5. With the armpit block now set, the climber can call down to the controller and inform them to set up the raising system

⚠WARNING

Be careful to not drop the armpit Omni Block® as it is unclipped from the harness. It will be heavy with the rope hanging in a bight from it.

- Once the armpit Omni Block® is set, the climber can call down to the controller and ground crew to begin rigging the rope out of the bag into the MPD® and subsequently pulling up of all the unwanted slack (but not tight).
- Once at the top, and the Petzl ASAP® is anchored, begin to re-stuff the belay line back into the bag. Pull on the free end (the part going to the stopper knot) and stuff into the bag until there is none left to pull up.
- Care must be taken by the climber to not twist any of the ropes. The ground crew may assist the climber in this task and work together in untwisting any ropes. If the climber left the ground with no twists, there should not be any issues later as he reaches his top position on the tower leg.

Figure 5.1.3.F.6. Ground crews set up raising system using Skyhook® capstan winch and 3:1 Z-rig pulley system. Man on left is pulling prusik and Omni Block® forward for maximum "throw" on this pulley system.

⚠WARNING

The main lifting/lowering side climber should never climb past the internal cross guy collars on the HVA/HVL tower.

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5.1.3.G MAIN GROUND CREW

Main lifting/lowering side ground crew responsibilities:

- As the climber takes the armpit Omni Block® and end of rope with ASAP® belay up the tower leg, the ground crew can begin making preparations for the main lifting/lowering line anchorages and pulley system.
- A "butt block" at the base of the tower leg will need to be established (exactly like the deflection line). Place an anchor strap at the base with a single sheave Omni Block®. Clip the rope coming out of the bag to this block. This can be done as the climber makes their way up the leg as it will not interfere.
- This butt block will need to "render" on the anchor strap and have a clear path to the armpit block above that the climber will establish soon. The rope cannot rub on the steel of the tower at any location.

⚠WARNING

All ropes must be free of the steel of the tower. Adjust rigging and blocks so ropes do not rub or abrade. Any rope that does inadvertently rub must be padded with a rope protector.

Figure 5.1.3.G.1. A fully "rendered" butt block on the base of a tower leg. Note that the anchor sling is installed in such a way that it cannot move up.

- A pulley system "throw" of between 5 and 35 feet is required for this task between the established butt block and the pulley system progress capture device (PCD). The CMC Rescue MPD® will be the PCD for the pulley system the ground crew will construct.
- A 3:1 (called a "Z-rig") is generally enough mechanical advantage for the main lifting/lowering line if the Skyhook® capstan winch is used for hauling, but more mechanical advantage may be needed if hauling is done by hand. Besides the MPD®, its anchorage and carabiner, you will need one prusik rope grab and one additional carabiner to construct the simple Z-rig.

Figure 5.1.3.G.2. Ground crews prepare to set up lifting/lowering main line in between the two sides of a single leg on a self supporting HVL tower.

- With the butt block positioned typically at the base of the tower, the use of a company vehicle becomes a logical choice for the PCD anchor (CMC Rescue MPD® location) as the vehicle can be moved to provide the appropriate pulley system throw. Long throws are better as seen in the illustration.

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Figure 5.1.3.G.3. Ground crews set up the Skyhook® capstan winch on the special bumper hitch mount supplied with the winch. Here they build the necessary 3:1 Z-rig in front of the progress capture MPD® for the lifting of the employee

- The opposite leg of the tower on the HVA is also a logical choice for the throw of a pulley system to be located. However, be mindful that the main lifting/lowering side may also desire that location for their pulley system so there may be some undesired overlap in the rigging there. However, if this area is covered with clean tarpaulins as discussed earlier, this may be the best way to keep your ropes clean.
- On the self supporting HVL towers (see photo) the base of the tower is wider which yields the perfect location for a short pulley system throw. Again, this area will need to be covered with clean ground tarpaulins.
- With the main lifting/lowering line side 250′ rope bag in hand, walk the rope to the MPD® location (the PCD).
- After the climber has reached their position above and established the armpit block on an anchor, load the CMC Rescue MPD® properly as shown. Close the MPD® face plate and use a carabiner to attach the device to its anchorage (secured vehicle, tower leg or other). Check the loading of the MPD® by briskly jerking the rope coming out of the device. It should lock up and give a clicking sound if done properly.

Figure 5.1.3.G.4. Ground crews use both legs of a self supporting HVL tower to operate the main lifting/lowering line pulley system (a 3:1 Z-rig) with a "throw" of about 14 feet.

⚠WARNING

Do not load the MPD® until the climber has reached their position on the tower leg above and anchored the armpit block.

- Slack in the main lifting/lowering line may be taken up by pulling on the "free end" of the rope coming out of the MPD®. The free end is the portion coming from the MPD® to the rope bag. Do not pull ropes up tight until the operation of lifting the employee is imminent. Leave ropes loose for now.
- Be ready to construct a pulley system (3:1, 5:1 or 7:1) by having on hand the needed Omni Blocks®, carabiners and prusik loops.

⚠WARNING

It is mandatory to have members of the ground crew check all rigging on the ground before the lifting operation takes place. Look for twisted rigging or anchor straps, open Omni Blocks or carabiners and rope that may rub on steel, obstructions or vegetation. Early correction before ropes are loaded is easier.

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5.1.3.H MANUAL LIFT

Manual lift or life-rated capstan winch:

Two methods of lifting are used depending on manpower and resources.

1. Manual lift with a mechanical advantage (pulley system) using manpower only. Various mechanical advantages can be built into these pulley systems depending on how many men are available for hauling.

Figure 5.1.3.H.1. PG&E ground crews hauling on a pulley system (this one happens to be a 5:1 "zig-zag").

2. Man-rated Skyhook® capstan winch with generator and power drill pulling on a mechanical advantage (pulley system). A heavy duty extension cord can be used to remove the generator fumes and noise from the operation.

Regardless of which is used, a mechanical advantage (pulley system) is built between the load (employee being lifted) and the source of power (hand haul or capstan with power). In this pulley system, the CMC MPD® is used as the progress capture for the lifting operation. This insures a safe lifting operation without the possibility of letting go or having the capstan suddenly un-spool catastrophically. The MPD® also serves as the friction appliance for gently lowering the suspended employee down to the ground when finished.

Figure 5.1.3.H.2.a. Photos showing the bumper mount for the Skyhook® life-rated capstan winch with Makita® 110v drill motor which has been adapted for this use. The will require the use of generator with heavy gauge extension cord so that the noise from the generator will not inhibit communication during lifting.

Figure 5.1.3.H.2.b. This picture was used in a controlled environment during training exercise.

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⚠WARNING

A truck mounted, engine driven capstan winch commonly used for power line work should never be used for lifting a live human load.

- A pulley system "throw" of between 15 to 30 feet is required for this task between the established butt block and the pulley system progress capture device (PCD). The CMC Rescue MPD® will be the PCD for the pulley system the ground crew will construct.
- A 3:1 (called a "Z-rig") is generally enough mechanical advantage for the main lifting/lowering line work if there is enough personnel. If this is not enough mechanical advantage, a 5:1 "zig zag" or 7:1 "double-single 7" pulley system can be constructed. The higher the mechanical advantage, the longer it will take to move the employee up. Consider using the Skyhook® capstan winch for ease of lifting with low manpower.
- Varying mechanical advantages: Besides the MPD® and its anchorage and carabiner:
  1. A 3:1 Z-rig will require one additional single sheave Omni Block®, one prusik rope grab and one carabiner.
  2. A 5:1 "zig-zag" will require two additional single sheave Omni Block®s, two prusik rope grabs and two carabiners.
  3. A 7:1 "double-single 7" will require one additional single sheave Omni Block®, one additional double sheave Omni Block®, two prusik rope grabs and two carabiners

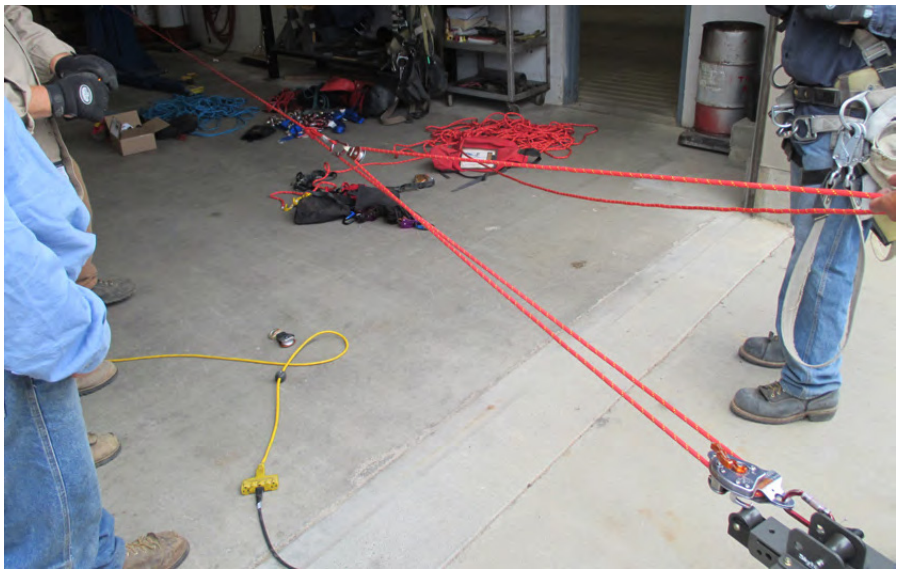

Figure 5.1.3.H.3. The MPD® at the rear of the 3:1 "Z-rig" pulley system as the progress capture. The "throw" of the pulley system is the distance between the haul prusik with pulley and the rear MPD® (anchored on the Skyhook® bumper mount).

Figure 5.1.3.H.4. Above, crews use the Skyhook® rear mount adaptor attached to the bumper receptacle of the crew truck.

Figure 5.1.3.H.5. The crew attached the Skyhook® capstan winch using supplied straps to the concrete footing of an HVL tower. Note the direction change directly above the winch guide roller which directs the rope into the 3:1 Z-rig pulley system with MPD® as the progress capture. Lining up all the ropes like this is important so ropes do not rub or abrade on the structure.

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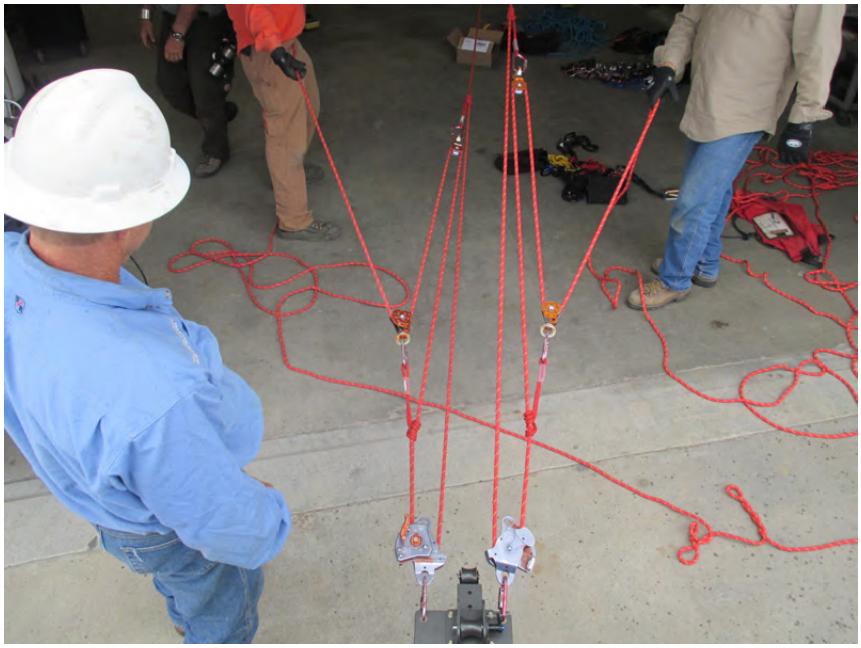
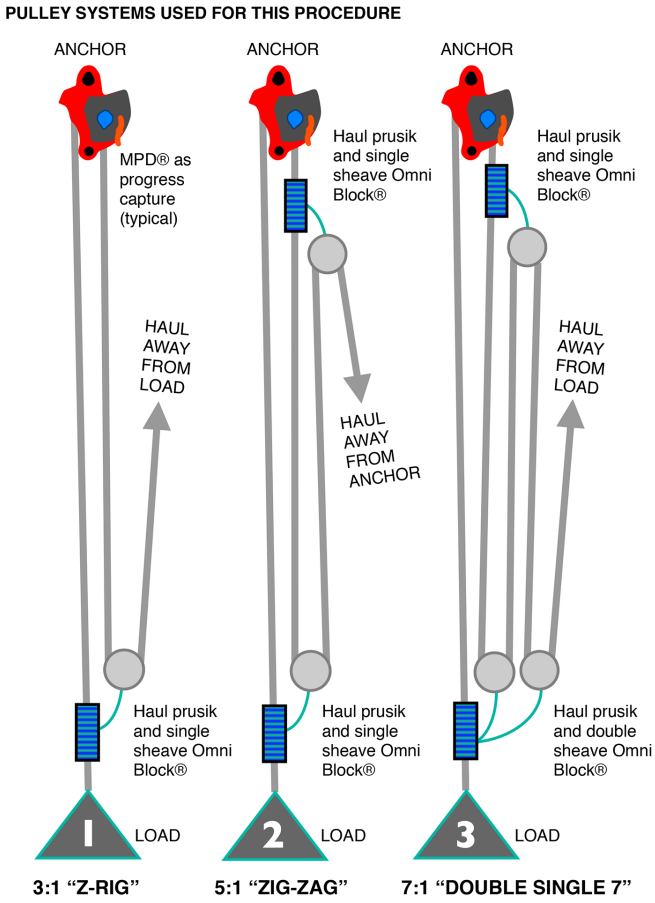


Figure 5.1.3.H.6. Crews practice building two side by side, but separate 5:1 pulley systems, called a "zig-zag 5:1" using the MPD® as a progress capture. Note how none of the systems are twisted or crossed over.



5.1.3.1 HARNESS OR SEAT

Employee lifted by harness or work seat

- A comfortable class 3 tower harness may be used if the suspension time is short.
- For reasons of comfort and to reduce or eliminate the possibility of harness-induced pathology (tourniquet syndrome caused by prolonged hanging in a harness), a work seat may be used for the suspended employee.
- The work seat is used in conjunction with the above mentioned harness. The seat cannot be used on its own unless it is a standalone Bosuns Chair.

Figure 5.1.3.1. PG&E employee being lifted in a tower harness with a built in seat structure which eliminates harness hang issues (tourniquet syndrome) associated with other style harnesses.

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5.1.4 FINAL SAFETY

5.1.4.A READY FOR EMPLOYEE SUSPENSION BY ROPE SYSTEM

Final safety check:

Before a rope access system is loaded, a safety check must be accomplished by all crew members involved. Generally, two sets of qualified eyes need to verify that all rigging has been done properly and safely. These two sets of eyes are:

1. The person who built the rigging. They check themselves.
2. The person in charge who is tasked with the safety of the entire operation. The use of binoculars to check remote rigging not reachable up on the tower is mandatory.

⚠WARNING

All crew members on the rope access maintenance team doing this work should be trained in all aspects of the rigging. Each person can determine if something is correct or not and can check each others work.

⚠WARNING

If remote rigging up on the tower cannot be satisfactorily checked from the ground and guaranteed correct, a second qualified climber should be sent up to check and verify the rigging before the employee is suspended from system.

Figure 5.1.4.A. A final safety check is required before employee is lifted off ground.

5.1.4.B TAKE UP SLACK

Take up all slack in system - ready to lift employee:

- As the slack is taken out of system by the lifting operation yet just before the employee is lifted off the ground, stop and adjust the deflection line position in or out. It is much easier to adjust this before their full weight comes onto the system.
- As the controller calls for taking up of all slack in preparation of lifting the employee ground crew members may position themselves at the MPD® with hands on the free end of the rope ready to pull.
- When they call for all slack to be taken up, one or more ground crew can pull on this free end. The MPD® will serve as the PCD and every inch of rope pulled through will be held securely.
- As the command is given to take up all slack in the main lifting/lowering line, stop as the employee is just off the ground a few inches and not in harms way. This will allow a brief secondary recheck of all systems, anchors, carabiners, etc. Look for cross loading, improper loading of carabiners, and other things it will be hard to correct once committed with a suspended employee.

Figure 5.1.4.B. PG&E employee leaning back on the main lifting/lowering ropes to weight the system before being lifted up.

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5.1.4.C BELAY ON

Belay on for both deflection and main lift/lower sides by climbers:

- Before lifting the employee, make sure both the deflection belay and main line belays are on. Ask each climber individually if belay is on and make sure you hear a response back that the belay is indeed on.
- The belay for the deflection line only may be locked. Simply switch the button to "Lock" on the Petzl ASAP® Lock device.
- Locking the belay on the main lifting/lowering line is not possible as it must be moved in and out according the ascent/descent of the employee suspended. This belay must be constantly monitored by the climber on that side. Never allow too much slack to form in the belay line.

⚠WARNING

Never allow too much slack to form in the belay line.

Figure 5.1.4.C. Belay is on. One can look up and see no slack in either the deflection belay (right blue), nor the main line belay (left blue).

5.1.4.D LIFT EMPLOYEE

Lift employee aloft:

- If belays are on, and the secondary quick safety check is complete, the ground crew can lift the employee. After the employee leaves the ground, it is prudent to allow them the control of the lifting operation as they will be approaching the guy intersection above.
- As the employee is being lifted off the ground, and no adjustments in or out are needed for the deflection line, the MPD® parking brake can be switched on (rotating lever anti-clockwise to "lock" position) and the free end of the rope can be tied off with a couple half hitches on a bight around the loaded deflection line leaving the MPD®.
- At this point, the deflection line is not moved again until the employee is on their way to the ground after the tensioning of the guys and all other work is completed.
- Adjust the suspended employees position up/down by the main lifting/lowering line and left right by the deflection lines.

⚠WARNING

The suspended employee may be injured by the guy wires when being lifted if the command for stop of slow is not heard in a timely fashion.

Figure 5.1.4.D.1. Lift employee off the ground a few inches while a final rigging check is performed.

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5.1.4.E ADJUST DEFLECTION

As lifting employee, adjust deflection line pulley position (in or out):

Any fine tuning of the loading deflection line should be done now as the employee is being lifted. This is easily accomplished by viewing the main lifting/lowering line and its position, left or right, of the internal guy intersection above. Letting out slowly on the MPD® or taking up on the pulley system will move the employee position left or right. This can be done concurrent with the employee is being lifted.

Figure 5.1.4.E. The deflection line is tied off and park brake is set after adjustments in deflection line are completed.

5.1.4.F APPROACHING GUY

When approaching guy intersection with suspended employee:

- The lifting operation should slow as the employee approaches the internal guy intersection from below.
- The suspended employee should switch to whistle commands so that his wishes can be heard over the generator or capstan drill motor (if used).
- If the power Skyhook® capstan is in high speed (which is anticlockwise on the winch), it should be switched to low speed (clockwise on the winch), or shut down altogether silencing the generator and drill motor. Use the hand crank on the capstan or simply go to by hand hauling on the pulley system.

Figure 5.1.4.F. Employee being lifted by rope access system towards HVL cross ties.

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5.1.4.G WORK COMPLETE, LOWER EMPLOYEE

- Once the suspended employee has reached their maximum height at the internal guy intersection, the pulley system ahead of the MPD® can be removed in preparation for lowering.
- After the work is completed at the intersection, the employee can give a verbal command to lower down.
- At the same time, the deflection line can simultaneously start to lower out, thus moving the suspended employee closer to the main lifting/lowering side of the tower. Due to the angle of the HVA/HVL tower legs, they will never come in contact with the leg.
- As the deflection line continues down, it will eventually come slack and the deflection yoke double sheave pulley will start to fall down along the main/belay lines until it finally reaches the suspended employee.
- Once the employee and the double pulley are on the ground, the deflection line and its belay line can be dropped to the ground without hardware attached.

⚠ WARNING

Never drop life safety hardware to the ground from a tower as this could damage it. Ropes may be dropped provided they land on a clean tarp.

5.1.4.H BREAKDOWN

- Once the employee is on the ground and free from lines, the ropes can be dropped to the ground onto a clean surface. The belay line which is contained in a bag (on the main lifting/lowering side only) can be re-stuffed into this bag on the tower and either carried down or dropped.
- Make sure everyone is aware ropes or bags are being dropped.
- Once ropes have been dropped, all anchor straps, pulleys and carabiners can be carried down by the climber on each leg.

5.1.4.1 RECORD KEEPING

- Inspections should be made by a competent person trained in inspection of rope access rope and equipment.
- All rope should be visually and hand inspected for any cuts, severe abrasions, or anomalies as it is re-stuffed into its rope bags.
- Life safety ropes should all be logged in a rope log book: (this should be found in the rope bag pocket and stays with the rope)
  1. Name of competent person making the log
  2. Date of use
  3. How many uses
  4. Used for what purpose - which procedure
  5. Rope identification (number)
  6. Length
  7. Color with tracer color
  8. Rope end used (A or B)
  9. Did it get wet? Dirty? Shock load? Someone accidentally drove over it? Special notes.
  10. Inspection results – in service or out of service

- Knots: Make sure each rope has a double overhand stopper knot in the end before it is stuffed into the bag. This knot should be at the bottom of the bag. The top end should also have a figure eight on a bight knot tied. Tails on all knots should be least 6″ long.
- Any hardware dropped by accident from the tower should be taken out of service and indicated so with black electrical tape around it.
- Hardware (MPD®, ASAP®, Omni Blocks® carabiners should be inspected. All gear that is dirty should be cleaned with a soft cloth.
- Prusiks should be inspected for abrasion and that their manufacturer installed shrink tubing and labeling are intact.
- Inspect harnesses used by the climbers and suspended employee. Note any wear points on critical stitching.

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- Inspect helmets used for cracks, deformities, etc.
- Inspect anchor straps for cuts or abrasion from tower steel.
- Inspect work seat if used.
- Skyhook® capstan winch:
  1. Inspection after each use for lubrication (EXTREMELY IMPORTANT!)
  2. Special Skyhook® Harken grease is contained in the Peilcan Case.
  3. Inspect Skyhook® 2″ red anchor straps for cuts or abrasion from tower steel or concrete footing.
  4. Follow Skyhook® manufacturer's instruction on how to lubricate the Harken winch.

⚠ WARNING

Severe damage to the internal gears of the Skyhook® capstan Harken winch can occur if not lubricated at the conclusion of each days operation

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