

# ACT Site Safety Manual

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## 1 Overview

This Safety Manual describes ACT policies and protocols for safety at the ACT site in the Parque Astronómico Atacama in Northern Chile, at the ACT low elevation base in San Pedro de Atacama (SPdA), and in transit between the site and SPdA.

This Safety Manual is accompanied by the ACT Safety Rules in Brief document (comprising excerpts from this Manual) which can be used as a quick reference. However, all ACT personnel who travel to the ACT site are required to read and be familiar with this entire Safety Manual. All ACT members are expected to be familiar with the Chajnantor Working Group (CWG) Policies. They can be found at [https://act.princeton.edu/sites/act/files/cwg\\_policies\\_0.pdf](https://act.princeton.edu/sites/act/files/cwg_policies_0.pdf). (Note that as of May, 2017, the CWG plans to upgrade this document, but a new version is not yet ready.)

This Safety Manual replaces several previous safety documents including the Interim ACT Safety Policies (May 2017), the ACT Safety Policy slide set (June 2016) and the ACT Truck Safety Policy (Jan 2009). It is a minor update to the December 2017 Safety Manual, which was itself a minor update to the July 2017 Safety Manual.

## 2 Emergencies

To be prepared for an emergency, learn the contact information described below and know where it is posted. Know how to use the ALMA radio and the satellite phone. If you need to contact ALMA on the radio and you do not speak Spanish fluently, request an English speaker: “Necesito hablar en Inglés.” If you are not trained in first aid and CPR, know which team members at the site are. On the mountain, pay attention to whether CLASS or POLARBEAR team members are at the site in case you need to call them for assistance. Note that you cannot rely on cell phone coverage while at the site or on the mountain roads. Keep the ALMA radios charged and tested. Use the ALMA radio channel 1 (channel 3 as back-up) to be put in touch with the site paramedic who will initiate emergency care and transport if any persons need immediate medical attention. See also other contact information below. In an emergency in which the satellite phone does not work, and you cannot contact ALMA via radio, use the SPOT tracker “Help” button which will notify the Director, the Deputy Director, and various other ACT senior faculty that you have an emergency and require assistance at the GPS location indicated by the tracker. (Do not use the SOS button.)

This Safety Manual does not define an ACT equipment problem as an “emergency” if there is no danger to personnel. Contact experts on Slack or by phone for help with such problems. However, if any event occurs which might cause environmental damage (an oil or diesel spill of more than two liters, for example), notify the Director or Deputy Director as soon as possible.

**What to do in an emergency situation:**

- Remain calm. If you find yourself becoming confused or anxious, stop what you're doing. Take a deep breath.
- Assess the situation for immediate possible hazards (live electrical lines, fire, mechanical structural damage, the possibility of overhead loads falling). Secure the area as needed. If there is unavoidable danger, leave the area. Assist others to leave.
- If an accident occurs in which others are injured, and you are alone, call for help first, and then assist the injured. Otherwise, work in parallel to call for help, secure the area, and assist the injured.
- To contact emergency personnel, your first contact method should be ALMA radio channel 1; if it is not available, use channel 3 as a back-up. On parts of the mountain road, the satellite phone (or the SPOT tracker if the satellite phone fails) may be the only working solution.
- Follow the directions of emergency personnel once you reach them on the radio or phone.
- After you and other are out of harm's way, contact the Director, Deputy Director or Director Emeritus (Staggs, Devlin, Page) as soon as possible to report the situation.

### 3 Responsibilities

Table B in Appendix A provides the names of the people with the job titles mentioned herein. The Director of ACT is responsible for keeping this Safety Manual current through a yearly review (to be completed by August each year), and for sharing the document as needed with other stakeholders in Chile, including other members of the Chajnantor Working Group (CWG), CONICYT, and ALMA. Safety incidents include accidents, injuries and near misses. All safety incidents must be reported to the Director and Deputy Director.

The North American Coordinator is responsible for maintaining records about visitors to the site, as described in Section 5.1, including the ACT Site Drivers registry, signed CONICYT waivers, confirmations of medical clearance, first aid and CPR certifications, and safety training certifications (see Section 6).

Each ACT team member who visits the site is responsible for reading and following this Safety Manual. It is the team members' responsibility to seek clarification if there are things they don't understand in the Safety Manual. Each visiting team member must read and sign the CONICYT waiver, available at <https://act.princeton.edu/sites/act/files/conicyt-waiver.pdf>. Each team member is responsible for carrying adequate water and cold weather clothes to and from the site. All team members are responsible for obtaining medical clearance from their doctors, as described below. All team members

are strongly encouraged to get training in CPR and first aid. In the case of postdocs and students, the postdoctoral mentors and the students' advisors are responsible for giving the postdocs and students access to this Safety Manual, communicating the importance of complying with these safety regulations, and providing guidance on traveling and working in Chile.

The Chief Safety Officer and the Deputy Safety Officer (who takes on the responsibilities of chief safety officer when the Chief Safety Officer is not present) are resident in San Pedro de Atacama. These safety officers are responsible for maintaining all the safety equipment (see Appendix C), periodic site inspections, keeping contact information in Appendix A up to date, and ensuring that the safety rules and policies are followed. See Section 8 for other specific responsibilities. The Safety Officers are responsible for training first-time visitors to the site in safe practices, and introducing them to the site equipment, including use of the telescope estops. The Safety Officers certify first-time visitors in safety. The Safety Officers must maintain their own CPR and first aid certifications. The Chief Safety Officer has stop work authority.

In some instances, an ACT faculty member can request to take over temporarily the responsibilities of chief safety officer while in Chile. The request must be made to the Director or Deputy Director. If the change is confirmed, the Director or Deputy Director will inform the resident Safety Officers. If neither resident Safety Officer is present at the site, the senior team member takes on the responsibilities of chief safety officer. The senior team member should confirm to the rest of the team that he or she is the acting safety officer before going to the site without the resident safety officers, or if the resident safety officers must leave the site or are incapacitated. Note that the chief safety officer is responsible for carrying out the protocols in Section 8.

## 4 High Altitude Policies

There are inherent risks in working at high altitude. The ACT site is at 5190 m. You should be prepared to recognize and respond to the symptoms of altitude sickness caused by the lower level of partial oxygen pressure in the lungs at high altitudes. More information can be found in <https://act.princeton.edu/sites/act/files/mma162.pdf> and other references.

**Medical Exam** All ACT team members required to work on the site must consult with their physicians to verify that there are no medical conditions that make it inadvisable to work at high altitude. Details about the medical examination requirements are given on the ACT public web site: <http://act.princeton.edu/policies>.

**Oxygen and Communication** Supplemental oxygen is always available at the site and in the trucks. You must be trained to use the supplemental oxygen system (regulators and

cannulas) and the pulse oximeter, usually by the safety officers. It is very important to be completely honest about how you are feeling at the site, particularly during the first few days of your first visit. You are strongly encouraged to use oxygen on at least your first day, even if you have been to the site frequently, and must do so if the site Safety Officer requests that you do. Monitor your blood oxygen level with the pulse oximeter. You must use supplemental oxygen if your blood oxygen level drops below 70%, or is sustained below 75% while sitting and breathing deeply. Don't try to "tough it out" if you are feeling bad. Use supplemental oxygen. You must use supplemental oxygen if you have an intense headache, dizziness, extreme shortness of breath, or other symptom of high altitude sickness. Stay in SPdA if you are under the weather. Report any symptoms that could be related to altitude sickness, even if they seem minor to you. Check on other people to make sure they are feeling OK at altitude, particularly if they appear incoherent or unusually irritable.

**Cognition** Mental functioning is impaired at high altitude. Double-check any important decisions you have to make while at the site with a second party. For critical decisions, seek confirmation from a team member who is not at altitude when possible.

**Ultraviolet (UV) radiation** The ACT site is one of the worst in the world for UV radiation intensity, which can damage your skin and eyes. Minimize direct exposure to the sun. Wear clothing that covers as much of you as possible. Wear sunscreen (SPF  $\geq$  30) on every part of you that is exposed and re-apply often. Don't forget the backs of your hands and the tips of your ears. Wear UV-protective eyewear when possible.

**Hydration** Not only is the air thin at the site, but it is also very dry most of the time. Symptoms of dehydration are similar to those from altitude sickness. Drink plenty of fluids while at the site. Ingesting an extra 1-1.5 liters per day is recommended (e.g. <http://www.altitudemedicine.org/myths-about-altitude/>; see also, e.g., <https://www.sciencedaily.com/releases/2007/08/070811225126.htm>) for recommendations for "usual" consumption levels.) A good rule of thumb to assess for hydration is the color of your urine: clear urine indicates adequate hydration, while dark urine indicates the need to drink more fluids.

**Acclimatization** Do not spend more than six hours at the site on your first day. Get plenty of sleep. Avoid alcohol for the first 48 hours in SPdA (and never drink alcohol at the site). Do not overdo aerobic exertion at the site during your first few days. Move slowly.

## 5 Visiting the Site

To get to the site, fly to Calama, Chile (airport code CJC). Your door-to-door travel time will probably be longer than 24 hours. Note that Chile strictly prohibits importation of a number of things, including dried fruits and peanuts. Before traveling, check the US State Department web site for possible travel advisories (<https://travel.state.gov/content/passports/en/country.html>.)

### 5.1 Before Traveling

This section refers to ACT team members traveling to the ACT site to work. Note that non-ACT visitors (excluding vendors) must be approved by Staggs, Devlin or Page. All visitors (or their parent companies, in the case of vendors) must sign the CONICYT waiver described below. Visitors are recommended to register their international travel with their universities (for example, through the CONCUR system if you have it).

Here is a list of things first time visitors need to do before traveling. Angela Lewis, at Princeton, is the North American Coordinator for ACT site visits. Miguel Angel Díaz is the SPdA Coordinator for ACT at the Radiosky Facility (RSF).

1. If you are not a US citizen, investigate whether you need a visa to travel to Chile.
2. Contact Lewis as soon as you know you will be traveling to the site. She will request your passport number and information about your driving experience.
3. Read this Safety Manual. It is available on the public ACT website: <https://act.princeton.edu/policies>.
4. Read the Medical Exam Requirements (<http://act.princeton.edu/policies>) and get medical clearance for high altitude work. Send Lewis confirmation of the clearance. Please note that you will need to consult with your doctor annually to confirm that you are still cleared in later years.
5. You are strongly encouraged to become CPR and first aid certified. If you have done so, send copies of your certification to Lewis and the Chief Safety Officer.
6. In most instances, it is advisable for you to do Remote Observations Coordinator (ROC) training before going down. Contact your advisor, or the ACT Director or Deputy Director for information on obtaining the training.
7. Read and sign the CONICYT waiver (<https://act.princeton.edu/sites/act/files/conicyt-waiver.pdf>) and return it to Lewis.
8. Take your university's lab safety training before coming to the site.

9. As soon as you have your travel dates, send them to Lewis. She will put you on the ACT calendar ([https://calendar.google.com/calendar/embed?src=b771h8dqe18avgecamktabt0gkgroup.calendar.google.com&ctz=America/New\\_York](https://calendar.google.com/calendar/embed?src=b771h8dqe18avgecamktabt0gkgroup.calendar.google.com&ctz=America/New_York)). Lewis will also contact the RSF to arrange a room for you, and to arrange a transfer (van service) for you from the Calama airport to the RSF.
10. It is recommended that you download the Google map of the site roads to your cell phone since GPS works on most of the CONICYT road, even when cell phone transmission does not. In any case, look at the map and consider printing paper copies as well.

### **5.1.1 Packing**

Bring this Manual. Read it again on the plane. Bring warm work clothes (thick socks, layered clothing including long underwear or tights, extra undershirts, a light jacket or fleece, but also a warm winter work coat, scarf, hat, waterproof gloves, etc). Bring good boots for walking in rough terrain. Be prepared for wind and snow. Since the SPdA pharmacy does not stock everything a US drugstore has, you may want to bring US over-the-counter medications like ibuprofen, benadryl, sudafed, etcetera. Bring any medications your doctor has recommended. Make sure you bring sufficient quantities of any medications for the duration of your planned trip, with a few days extra in case of travel delays. Bring toiletries (including soap and shampoo, which are not provided at the RSF), dry weather protection (lip balm, lotion), and sunscreen with SPF of 30 or higher for at least your face (wear it every day). Lip balm with UV protection is also useful, and many people like to have sunglasses. Many people like to bring (in checked baggage) a pocket knife or other pocket tool and a flashlight or head lamp. Bring a US-to-Chile AC plug adaptor (Type L) for use at the RSF for your items (like computers) which can run from 220 V/ 50 Hz. Note that power at the site, in contrast to at the RSF, is almost all US 60 Hz/120 V. It is not advised to use spinning hard disk drives (HDD) at the site as they can be damaged at the low pressure obtained at the site. Solid state drives (SDD) do well.

### **5.1.2 Carrying ACT Property**

If you are carrying any parts for ACT, make sure to have some documentation for them, including their price, and the explanation that they are not intended for resale. If you are carrying expensive parts, we will need to contact our customs agent in Chile. Consult Devlin, Staggs, Page or Rolando Dünner.

## **5.2 Upon Arrival**

Once you get to SPdA, introduce yourself to Díaz so you know where to find him in case of an emergency. Note that you should not drink the tap water at the RSF due to its



trace levels of arsenic. Do hydrate by drinking water “sin gas.” Do not go up to the site on the first day you arrive if it is your first visit. Do not spend more than six hours at the site on the first day of your first visit. It is important to acclimatize to the elevation gradually. When you get to the site for the first time, ask the site engineer(s) for a tour so you learn where everything is, including safety equipment. Learn where the passwords for the CLASS and POLARBEAR wifs are, and the codes to get inside their containers in case of emergency. Learn to use the oxygen equipment.

## **6 Training and Certification**

ACT Team members visiting the site for the first time must undergo a two-part safety certification. The first step is to meet with the Chief Safety Officer or the Deputy Safety Officer in SPdA, confirm that you completed your university’s safety training, confirm that you have read this Safety Manual, and ask questions to clear up any confusion you might have after having read it. The second step is safety training at the site, during which you will learn how to operate the ALMA radio, the GPS tracker, the satellite phone, the supplemental oxygen systems, the telescope emergency stops, where to locate the site safety equipment (see Appendix C), and how to perform the site daily checklist. When both steps have been completed, the Safety Officer who performed the training will notify you, Lewis, the Director, and the Deputy Director that you have been certified. It is the Safety Officer’s responsibility to ensure visitors are trained on the site’s safety protocols and procedures. Lewis is responsible for maintaining the records of certifications. Certification is mandatory for repeated access to the site.

## **7 Safety Policies**

Do not take the attitude that you can use your own judgment on taking risks. Know the safety policies and when in doubt, take the most conservative course. Ask a senior team member if unsure. The team depends on you. Always have access to at least two of three means of communication while at the site: the ALMA radio, the satellite phone, or the internet. Know how to use them all to contact emergency personnel including ALMA safety.

### **7.1 Transit between the Site and SPdA**

There are two main routes from SPdA to the site. The first is the paved Paso de Jama road followed by the “CONICYT road” which begins at km 35. The second is the paved Rte 23 to the ALMA road to the AOS (Array Operations Site), followed by a road on the ALMA plateau that connects to the CONICYT road near the site. There are also other mountain roads off the Paso de Jama road, including the km 45 “Pampa La Bola” road into

the ALMA plateau near ASTE. To use ALMA roads, ACT personnel must get in touch with the ALMA safety office. (See contact information in Appendix A.) ALMA must be informed of fuel and other deliveries that come through the Pampa la Bola road.

ACT will maintain the ACT Site Drivers registry for drivers approved for travel on the mountain roads to the site. Only registered/approved drivers are allowed to drive to and from the site except in specific training scenarios which must be OKed by Staggs, Devlin or Page. Once a team member is experienced and confident at driving a manual transmission vehicle, the team member can be trained in use of the 4WD truck in good conditions.

### 7.1.1 ACT Safety Policies for Transit

- There must always be at least two people in the truck and at the site<sup>1</sup>.
- A truck approved for use must be equipped with a roll-over protection bar. Everyone in the truck must wear a seatbelt. Don't use the phone while driving. Alcohol use is prohibited.
- In the truck must be: charged ALMA radio, charged GPS tracker, charged satellite phone, snow chains, shovels, water and cold weather clothes for everyone in the truck, bottled oxygen, first aid kit, fire extinguisher, spare tire, windshield scraper, ropes or tow strap.
- It is highly recommended to also carry a spare set of insulated work coveralls, spare work gloves, a spare hat and at least four heavy-duty space blankets, an emergency light, a supply of high-protein snacks (like energy bars) and at least two spare snow chains in the truck as well. It is also recommended to use a truck equipped with a tow hook on its back bumper.
- Always use the transit alarm button on/off. This web-based button notifies the remote observer when you are leaving from / returning to San Pedro de Atacama, and then when you have arrived at the destination. An alarm is emailed if the trip is longer than 2.6 hours.
- Do not pass unsafely on the Paso de Jama or en route to Calama. Never pass on the curved sections of the Paso de Jama. Look out for broken-down trucks or animals on the road.
- Obey posted speed limits. Do not exceed 60 km/hr on any dirt road. On the CONICYT road, do not exceed 50 km/hr and always use your headlights. In general,

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<sup>1</sup>In exceptional circumstances (such as when the presence of colleagues on the Parque Astronómico Atacama concession has been confirmed, and/or when colleagues in North America are in close and frequent Slack contact), experienced ACT personnel who are approved drivers may be allowed to drive to and from the site alone during daytime hours. Confirm with Staggs, Devlin, or Fankhanel before doing so.

drive for the conditions as you find them: more slowly around the curves (30 km/hr or down to 10 km/hr on steep curves), more slowly when the road is rough or icy, etc.

- Do not encourage drivers to drive faster than they are comfortable with. If driving in a caravan, make sure the slower driver goes first.
- Do not drive if exhausted or feeling unwell. Keep in mind that mental functioning is impaired at high altitude.
- Be particularly careful to watch your speed when descending. Downshift to use the engine for braking and keep the brakes cool. Nearly all ALMA accidents have occurred during descent. If driving in the dark after having been at the site for more than three hours, it may be beneficial to use oxygen.
- If there is a truck accident, contact ALMA immediately on Channel 1 on the radio (Channel 3 for backup). Stay with the truck until help arrives. In case of emergency, assess the situation, administer basic first aid as necessary, call ALMA, then contact Miguel Angel Díaz in San Pedro de Atacama, and finally, contact Staggs, Devlin, Page (or the ROC if the others are unreachable) in North America. As a last resort, if you cannot contact ALMA on the radio, and the satellite phone is not working, use the “Help” button on the SPOT tracker. (Do not use the SOS button.)
- In the case of other problems with the vehicle, such as flat tires, overheating, or other issues, assess the situation. If the weather conditions are good, and you feel confident to do so, attempt to repair the problem. If you cannot repair the problem, and the weather conditions are good, contact Miguel Angel Díaz and/or colleagues from ACT, CLASS or POLARBEAR to arrange to be picked up. If the environmental conditions are not good, contact ALMA on Channel 1 on the radio (Channel 3 for backup). Stay with the truck until help arrives. (As a last resort, if you cannot contact ALMA on the radio, and the satellite phone is not working, use the “Help” button on the SPOT tracker; do not use the SOS button.)
- Do not go up to the site if the ALMA road to the AOS is closed due to bad weather at the high site. Check for email to the CWG mailing list about road closings before every ascent. Call the ALMA safety office (see Table A) if you are unsure.
- When there is more than 5 cm of snow on the mountain road, follow the ACT Snow Guidelines described in Section 7.1.2.
- If you are stuck in the snow in one place for more than 30-60 minutes without another reliable source of assistance,<sup>2</sup> contact ALMA safety on Channel 1 on the radio.

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<sup>2</sup>For example, another reliable source of assistance might be another truck with whom you are in contact, within easy walking distance lower down the road, which is not stuck in the snow.

- No one may ride in the open bed of a truck; that area is for cargo only.
- Do not pick up hitchhikers. Assist anyone in need without putting yourself into danger. For example, call for assistance.
- Take extra care when dark. When dark, do not use the km 45 exit to the Pampa la Bola road. Use the CONICYT road or the ALMA road.

### 7.1.2 ACT Snow Guidelines

Do not attempt to ascend to the site with less than half a tank of diesel in the truck if there is snow  $\geq 5$  cm deep on the road.

- Caution is strongly advised under the following circumstances with snow  $\geq 5$  cm deep on the road. If two or more of the following apply, **do not attempt to ascend to the site.**
  1. When driving with little prior experience in snow and/or off roading, or if unsure/anxious.
  2. When driving with a single truck.
  3. When driving a truck without snow chains and/or mud terrain (MT) tires.
  4. When riding in a convoy (2 or more trucks) in which one is without a complete set of proper equipment (hooks/shackles, tow straps, shovels, snow chains).
  5. When starting the ascent in snow later than 2pm.
  6. When starting the ascent in the face of forecasts of bad weather (snow or high winds) or actual bad weather conditions.
- If any of the following conditions holds, **abort the attempt to ascend to the site.**
  1. If snow is not packed down and is deeper than: 15 cm for a truck without MT tires and/or chains, or 30 cm for a truck with MT tires and/or chains.
  2. If strong winds are present ( $\geq 45$  km/hr).
  3. If patches of snow are deeper than 50 cm and longer than 2 m.
  4. If visibility drops below:  $\sim 30$  m before 2 PM, or below  $\sim 50$  m after 2 PM.
  5. If you lose a chain more than once, or if a chain fails (links, locks, shackles, etc. get damaged).
  6. If you are in a single truck and get stuck more than once in the same spot/area, or more than 3 times on the whole route.
  7. If you are in a convoy and one truck gets stuck more than once in the same spot, or if the other vehicles get stuck as well, or if the convoy has to halt in one spot for more than 20 minutes.

8. If weather conditions suddenly worsen and linger for more than 20 min (quick drops of temperature and/or visibility, strong gusts of wind, snowing/hailing, etc.)
  9. If the snow is blowing and/or falling sufficiently to cover up the tracks of the truck in 15 minutes or less.
- You should also check in with the rest of the team and/or convoy if you get stuck or lose a chain even once, and consider aborting the attempt to ascend at that point if it is late, or team members are too cold or tired. Safety is more important than accessing the site.

## 7.2 At the Site

Here are policies for work at the site, in addition to the high altitude considerations described above.

- No one should be left alone on the mountain<sup>3</sup>. If you are working in a space apart from other team members for some task, aim to check in with the others every hour.
- Except in case of emergency, do not spend the night at the site.
- Use supplemental oxygen as needed. Use sunscreen during the day.
- Know the wifi passwords and container lock combos for the other projects at the Toco site in case of emergency. Know where to find emergency contact information.
- Know how to use the telescope emergency stops (estops). Always use an estop when working on the telescope. Take responsibility for confirming yourself that an estop is engaged before accessing the telescope, and if you were to notice a colleague forgot to use one, you should engage an estop and let the colleague know.
- Take your university's lab safety training before coming to the site. Be familiar with and follow all the usual lab safety requirements.
- Don't use equipment you haven't been trained on. For example, read about extension ladders before using them (<https://www.osha.gov/Publications/OSHA3660.pdf>) and ask a senior colleague if you have questions.

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<sup>3</sup>In exceptional circumstances (such as when the presence of colleagues on the Parque Astronómico Atacama concession has been confirmed, and/or when colleagues in North America are in close and frequent Slack contact), experienced ACT personnel may spend a limited amount of time alone on the site. Confirm with Staggs, Devlin, or Fankhanel before doing so.

- The site must be maintained with supplemental oxygen, first aid kit, fire extinguisher, water and food supplies. Contact information must be posted, and this manual must be available at the site. It is highly recommended to have a spare drum of potable water on site for use on injuries, and a working AED. Everyone working at the site should know where to find these items and should know who at the site is CPR and first aid qualified.
- Pay attention to the weather. Check for ALMA emails to the CWG every few hours. Descend if it gets bad (more snow than a snow shower, decreasing visibility).
- Do not feed any wildlife.
- Harming any cultural heritage (including archaeological ruins) is forbidden, as is hunting or disturbing native animals. Any environmental damage or accident must be reported verbally to Staggs or Devlin within 24 hours for reporting to CONICYT.

### 7.3 In SPdA

The guiding principle for safety considerations in SPdA (besides not drinking the tap water) is communication. Before going your separate ways after a trip to the site, clarify the plan for meeting up for the next day and/or going up to the site next. Make sure the site engineers and the senior person in charge know the plans. Notify the ROC if you are going to Calama. Drive safely and don't pick up hitchhikers. Drive and behave courteously in town.

## 8 Protocols

Unless otherwise specified, these standard protocols for maintaining safety are the responsibility of the Safety Officers at the site. Standard procedures for first time visitors were described in Section 5.1. All ACT team member visitors should read this section anyway. It is the responsibility of ACT visitors to report any concerns about safety at the site to the Safety Officers, and to Staggs and Devlin if the concerns are not resolved by the Safety Officers.

- Keep current safety information posted at the site and/or on the site wiki (emergency contact information, first aid poster, lab safety information as needed). Once a month, confirm the emergency contact information in Appendix A of this manual is current, and report any necessary changes to the ACT Director.
- Keep the satellite phone charged and programmed with all the useful emergency contact numbers. Verify service is active once a week.

- Every time you get in the truck to head up to the site, check the fuel level (more than a third of a tank in good weather; more than half a tank if the roads or weather are poor), check that the ALMA radio, the satellite phone, and the GPS tracker are charged, check that the weather conditions are OK (and that the ALMA road to the OSF is open), check that you have warm clothes and water, and check you still have the rest of the safety equipment in the truck. Also set the Team Toco transit alarm when leaving and returning: <https://actexperiment.info/control/>.
- Perform the two-step certification process for each first-time visitor described in Section 6. In the first or second day, have first-time visitors help with site check lists and straightening up so they learn where things are kept. Develop a checklist of things to show newcomers – for example: where the car battery charger is, what the gate passcodes are, where the PB and CLASS wifi passwords and lock combinations are listed, where batteries, flashlights, warm suits, spare gloves, food and water are kept, where tools, ropes and straps are kept, how to use the ALMA radio.
- When accompanying people to the site on their first day, check in on their health each hour on the first day. Show them how to use oxygen even if they don't feel like they need it so they can do it themselves if need be, and so they can see if they do actually function better with it.
- If going up when the weather is questionable, check that every item that is required to be carried in the truck is present and in good shape. This list includes the full set of warm clothing for each team member. Double-check you have notified the ROC of transit. Confirm that you have more than 3/4 tank of fuel.
- If going up in a convoy in questionable weather, check that the other trucks have safety equipment or that you are carrying enough spare equipment (e.g. oxygen, water) for everyone.
- What to do if your truck gets irrevocably stuck in the snow:
  - If leaving in a second truck, lock the snowbound truck and capture its GPS coordinates with your cell phone. Make sure to take your water, warm clothing, etc with you.
  - If you are close enough to a well-plowed road, use the satellite phone to call colleagues from CLASS or PB to pick you up. Wait in the truck for as long as possible.
  - If you are close enough to walk to the site, use the satellite phone to notify the ROC, Staggs, Devlin or Page that you are doing so, and check in with that contact when you arrive. Capture the truck's GPS coordinates before you leave it. Take the SPOT tracker with you.

- If the weather is bad or the sun has gone down, contact ALMA. If you need to stay in the truck for a long period, shut the engine off for 30-40 minutes out of every hour to conserve fuel, but run it in between to keep the battery alive and to run the heater. When the engine is on, rev it to 2000 rpm for a few minutes to get the temperature gauge to come off the pin if needed. Check that the tailpipe is clear, and periodically switch the air circulation to external to avoid CO poisoning.
  - In an emergency in which the satellite phone does not work, and you cannot contact ALMA via radio, use the SPOT tracker “Help” button which will notify the Director, the Deputy Director, and various other ACT senior faculty that you have an emergency and require assistance at the GPS location indicated by the tracker. (Do not use the SOS button.)
- Once a week, check the truck tire treads and lights, and clean the front windscreen. Check first aid kit, and other safety equipment for the truck (including food) are all present and in good shape. Check batteries are charged for the ALMA radio, the GPS tracker and the satellite phone. Check that the truck registration and insurance documents are still in the truck glove box.
  - Once a week, check the oxygen supply at the site and in the truck. Make sure there are sufficient working regulators and cannulas. Look at the calendar and make sure to have enough ordered for incoming visitors.
  - Once a month, check site safety equipment is in good shape (first aid kit, fire extinguishers, sleeping bags, emergency water container, enough food for a week for four people, AED if possible).
  - Once a month, do a walk-through safety inspection of the site. Report any problems to the Project Director and Deputy Director immediately.
  - Once a year, work with Princeton University to perform safety certification of the site.
  - Once a year, Staggs will lead a review of this Safety Manual (in July-August), and confirm ALMA has appropriate contact information for North American ACT management (at the yearly CWG meeting in the late spring), and passport and local contact information for longterm site employees.



## A Contact information

Table A provides critical contact information. The column labeled “from non-Chile line” shows how to call from a US (or other non-Chilean) cell phone or from Skype. The column labeled “from Chile mobile” shows how to call from a Chilean cell phone. Table B gives the job titles of some of the people named by name here.

Emergency Contact Information			
Primary method of reporting emergencies: ALMA radio channel 1			
Contact	from non-Chile line	from Chile mobile	Comments
Reporting Emergencies to ALMA	+56 2 2467 6555	2 2467 6555	(radio contact preferred)
ALMA OSF First Aid Station	+56 2 2467 6400	2 2467 6400	
ALMA AOS First Aid Station	+56 2 2467 6532	2 2467 6532	(high site)
ALMA Safety Manager	+56 9 7559 4755	9 7559 4755	(cell phone)
ALMA Deputy Safety Manager	+56 9 4234 8247	9 4234 8247	(cell phone)
SPdA Health Clinic	+56 55 285 1010	55 285 1010	(24 hr)
SPdA Police Station	+56 55 275 5350	55 275 5350	(Spanish required)
Miguel Angel Díaz	+56 9 4228 4382	9 4228 4382	(cell phone)
Max Ernesto Fankhanel Parraguez	+56 9 6832 6576	9 6832 6576	(cell phone)
Diego David Maldonado Espindola	+56 9 9689 3317	9 9689 3317	(cell phone)
Rodrigo Guillermo Freundt Rueda	+56 9 3884 8825	+56 9 3884 8825	(cell phone)
Rolando Dünner	+56 9 824 98194	9 8249 8194	(cell phone)
Suzanne Staggs	+1 609 468 3086	+1 609 468 3086	(US cell phone)
Mark Devlin	+1 267 243 9865	+1 267 243 9865	(US cell phone)
Lyman Page	+1 609 216 3172	+1 609 216 3172	(US cell phone)
Angela Lewis	+1 609 258 0720	+1 609 258 0720	(US landline)
Deniz Augusto (CLASS)	+56 9 4401 6424	9 4401 6424	(cell phone)
Julianna Couto (CLASS)	+1 202 460 3308	+1 202 460 3308	(US cell phone)
José Cortés (POLARBEAR)	+56 9 8149 0241	9 8149 0241	(cell phone)
Nolberto Oyarce (POLARBEAR)	+56 9 9218 8202	9 9218 8202	(cell phone)

More emergency contacts may be found on p. 22 of the ALMA Safety Manual, [https://wikis.alma.cl/twiki/pub/ALMASafety/SafetyTopDocuments/Alma\\_2012\\_accepted\\_signed\\_Manual.pdf](https://wikis.alma.cl/twiki/pub/ALMASafety/SafetyTopDocuments/Alma_2012_accepted_signed_Manual.pdf). Note that a number of satellite phone numbers are listed there, but ALMA has informed us those phones are not usually turned on; they are for calling **out** in emergencies. Thus you might be contacted via a satellite phone number like 00 8816 224 12017 (or 12016 or 27616 for the last block of digits).

## B ACT Project Positions

Table B lists the names of ACT personnel filling jobs mentioned by title in this document.

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ACT Project Staff	
Position	Name
Director	Suzanne Staggs
Deputy Director	Mark Devlin
Director Emeritus	Lyman Page
Telescope WBS Leader	Rolando Dünner
Chief Safety Officer	Max Fankhanel
Deputy Safety Officer	Diego Maldonado (interim)
Engineers	Max Fankhanel, Rodrigo Freundt, Diego Maldonado
North American Coordinator	Angela Lewis
SPdA Coordinator at Radiosky Facility	Miguel Angel Díaz

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## C Safety Equipment

Table C lists safety equipment which is maintained by the Chief Safety Officer with assistance from the Deputy Safety Officer. See Section 8 for more details on protocols for maintaining the equipment.

Safety Equipment		
Description	Usual Location	Comments
ALMA radio	ACT truck	Keep charged
GPS tracker (SPOT)	ACT truck	Keep charged; turn on during travel
Satellite phone	ACT truck	Keep charged; verify service is active
Snow chains	ACT truck	
Snow shovel	ACT truck	
Tow strap or ropes	ACT truck	
Spare tire	ACT truck	
(Personal water)	ACT truck	(each ACT team member's responsibility)
(Personal cold weather clothes)	ACT truck	(each ACT team member's responsibility)
Other truck supplies	ACT truck	As described in Section 7.1.1, second bullet
Medical oxygen equipment	ACT truck	Maintain oxygen, cannulas & regulators
Medical oxygen equipment	control room	Maintain oxygen, cannulas & regulators
First aid kits	ACT truck	Must replenish as needed
First aid kits	control room	Must replenish as needed
First aid kits	SPdA lab	Must replenish as needed
Fire extinguisher	ACT truck	
Fire extinguisher	control room	
Fire extinguisher	SPdA lab	
Fire extinguisher	generator shed	
Site water supply	control room	
Site food supply	control room	(or in site food storage container)

## D Acronym Dictionary

Table D defines the acronyms used in this document.

Acronym Dictionary	
Acronym	Long form
4WD	Four Wheel Drive
ACT	Atacama Cosmology Telescope
ACTPol	ACT Polarimeter
AdvACT	Advanced ACTPol
AED	Automated External Defibrillator
ALMA	Atacama Large Millimeter Array
AOS	Array Operations Site
ASTE	
CLASS	Cosmology Large Angular Scale Surveyor
CO	Carbon Monoxide
CONICYT	Comisión Nacional de Investigación Científica y Tecnológica
CPR	Cardiopulmonary Resuscitation
CWG	Chajnantor Working Group
GPS	Global Positioning System
HDD	Hard Disk Drives
MT	Mud Terrain
OSF	Operations Support Facility
PB	POLARBEAR project
ROC	Remote Observations Coordinator
RSF	Radiosky Facility
SDD	Solid State Drive
SPdA	San Pedro de Atacama
WBS	Work Breakdown Structure

## **E Changes with respect to previous version**

Removed Rodrigo Quiroga and added Rodrigo Freundt in lists of Project Positions and Contact Information