EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral
Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

Safety Manual
La Silla Paranal Observatory

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Applicable Documents

AD Nr	Doc Nr	Doc Title	Issue	Date
AD1	SAF-GEN-POL-0001	ESO Safety Policy and Organisation	1	21.07.11
AD2	LPO-PRO-ESO-20100-0003	LPO Driving Procedure	2	09.05.12
AD3	LPO-PRO-ESO-20100-0002	Hazardous Material Procedure LPO	4	05.05.12
AD4	LPO-PRO-ESO-20100-0004	Emergency Coordinator Procedure LPO	3	07.05.12
AD5	LPO-PLA-ESO-00000-3398	Emergency Action Plan	2	22.08.06
AD6	VLT-PRO-ESO-11000-3396	Lockout/Tagout Procedure for Telescopes	2	16.08.04
AD7		General Conditions of ESO Contracts		Oct 2011
AD8	Memo	LPO Contractor Safety Procedure		18.02.11

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1 Objective

Based on the **ESO Safety Policy and Organisation (AD1)** this document is to further specify the safety rules for the La Silla Paranal Observatory (LPO) sites in Paranal, La Silla and APEX, including the offices in La Serena and Antofagasta.

It applies to all ESO members of personnel, contractors, and visitors on LPO sites at Paranal, La Silla and APEX.

2 Safety at LPO

The LPO Safety Office supports the overall mission by providing guidance and advice to management, personnel, (contractors) and visitors in all matters of Safety and by preparing to manage emergency situations that might affect people or facilities within the observatories.

Every single member of personnel, contractor, or visitor contributes with a safe behaviour to ensure the operation of the observatories.

Therefore risks and vulnerabilities have to be minimized. No task is so important that it should be done in a manner which permits unacceptable risks to personnel or property.

3 Organisational Structure LPO

The current organisational structure of LPOis published atthe Director's Office page http://director.pl.eso.org under

LPO Organization Chart.

4 Responsibilities

Safety responsibilities and functions are detailed in **ESO Safety Policy and Organisation (AD1)**. For LPO specifically:

- LPO Director/ Site Safety Responsible
- LPO Site Safety Engineer
- Department Heads
- Safety Engineers
- Supervisors
- Project Managers

- Garching members of personnel on business trips or projects have to comply with all LPO safety regulation during their stay at one of the sites.

- Contractors responsibilities are defined in **ESO Safety Policy and Organisation (AD1)**, and also in **General Conditions of ESO Contracts (AD4)**, and **LPO Contractor Safety Procedure (AD5)**.

- Visitors are responsible for their own safety. They need to follow all LPO safety rules and shall always follow instructions from their guide(s).

  Public visitors need to sign a release form before entering the site(s). The release form is available at the Safety webpagehttp://safety.pl.eso.org under

  Safety Documents & Procedures.

4.1 Hazard Recognition and Control

4.1.1 Hazard Analysis

Hazard Analysis (HA) is the fundamental tool to identify possible hazards in the workplace. It shall be applied to workplaces, work activities, and equipment.

It is a supervisor's responsibility to perform it before and during work activities.

Each supervisor shall perform regular workplace inspections in his designated area. Furthermore the Safety Office will conduct regular workplace and facility inspections.

After the inspection the Safety Office will prepare a report and submit it to the responsible person of the area.

If required special inspections can be requested from the Safety Office at any time.

Identified hazards will be assessed in probability (A – D) and severity (1 – 4), assigned a Risk Code and entered into the LPO PPRS system. This ensures that all risks are followed up until they are mitigated and that higher risks are fixed quicker.

The following chapters list hazards likely to occur at LPO premises and how to mitigate the risks.

The list does not exclude any other hazards from occurring. The responsible supervisor always shall assess the risks individually.

4.2 Work Related Hazards

The following chapters list some work specific hazards that might occur when working on site.

4.2.1 Electrical works

Only persons who have received training in and have demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved, or are under such supervision as is necessary for the work undertaken shall be permitted to perform electrical works.

When working on electrical equipment, basic procedures to follow are to:

- de-energize the equipment,
- use lockout and tag procedures to ensure that the equipment remains de-energized(template available at the Safety website:

  Electrical Work

- use insulating protective equipment, and
- maintain a safe distance from energized parts.

Main Risks when dealing with Electricity are:

Electric Shock — results in a convulsive response by the nervous system to the passage of electricity through the body

Electrical Burns — usually occur on the surface of the skin at points of contact where electricity passes through the body.

Fires — can be caused by

- leakage of current due to poor, damaged, or insufficient isolation.
- overheating of electrical equipment due to overloading (for example by daisy-chaining, or using multiple outlets)
- ignition of flammable vapour by electrical equipment that is not operating normally

Electric Arcs	can occur when the potential in a conductor is great enough to create a conductive path between that conductor and another which is at a lower potential. The resulting arc will be capable of crossing the air gap or insulation which separates the two conductors.
Static Electricity	build up of electrons on poor conductors of electricity resulting in sudden discharge. While this may only produce discomfort in the human body it might damage sensitive equipment.

4.2.2 Working at Heights

Anybody working in heights of more than 2 meters or who can fall down more than two meters shall be protected from falls, either by a

- Guardrail
- Safety net, or
- Personal fall arrest system

When working at heights is necessary, make sure

- A proper risk assessment is done by the supervisor
- To use appropriate equipment for the job
- Equipment is well maintained, checked, and installed properly
- Personal fall arrest system is not damaged and properly fitted
- Personnel is physically capable and qualified

Main Risks when working at heights are:

Falls of people

Falls of material

Falls from or through fragile roof parts or guards

Prevention measures:

Provision of a safe access when working at heights:

Portable Ladders

- Ladders should have no damaged, loose, or missing parts
- Ladders should be properly erected and secure
- Ensure the ladder projects at least 1m above the landing place
- Ensure the ladder is set at the correct angle of 75 degrees and is on firm ground
- Always have three points of contact on a ladder: 2 feet and one hand, or 2 hands and one foot
- Don't use portable ladders as work place. Use only for activities less than 2 hours

Fixed Ladders

- Design of fixed ladders shall be in accordance with European Norm (EN) 14122-4 "Safety of Machinery – Permanent Means of Access to Machinery – Part 4: Fixed Ladders" orOccupational Safety and Health Administration (OSHA), Code of Federal Regulations (CFR) 1910.27 "Fixed Ladders"
- Fixed ladders shall be used only if
    - by design a safety cage is around the fixed ladder, or
    - when suitable individual protective equipment is available
- fixed ladders shall not be accessed when working alone

Provision of safe workplaces when working at height

Mobile working platforms

- Design of mobile working platforms shall meet requirements of EN 1004 "Mobile Access and Working Towers made of Prefabricated Elements"or OSHA CFR 1910.29 "Manually Propelled Mobile Ladder Stands and Scaffolds (Towers)"
- Mobile working platforms shall be set up only by qualified personnel
- Set up shall only be done according to manufacturer's instructions
- Mobile working platforms shall only be used on even and compact ground
- It shall be protected against tipping
- Usage shall be prohibited in strong winds

- Mobile tower working platforms shall not be moved while workers or material are on the platform
- Safe access shall be provided inside the platform

Scaffolding and fixed working platforms

- Design of scaffolding or scaffolding parts shall meet with European Norm 12811: Temporary Works Equipment
- Set up of scaffolding shall only be done by qualified personnel and according to instructions of manufacturer
- Erected scaffold shall be certified and labeled with a tag, identifying name of company, maximum load and name of responsible person
- No changes shall be done to an erected scaffold unless responsible person authorizes them
- Damages should be notified immediately to responsible person
- An appropriate access inside tha scaffolding shall be provided

4.2.3 Mobile Elevated Working Platforms (MEWP)

MEWP's (for example a "Sequani"), shall only be operated by certified personnel that have been trained on operating procedures, safety requirements and hazards.

A list of certified LPO personnel is available at the LPO Safety website:

Certified Personnel for Lifting Equipment

Main risks when operating MEWP's are

Falls of people or material

Entrapment	at moving parts of the equipment or between equipment and any fixed obstruction
Overturning	on uneven or soft ground; operating on a slope; operating in wind speeds exceeding those specified by the manufacturer

Prevention measures

- Don't operate equipment if you are not trained to do
- Always wear personal fall arrest system
- Ensure MEWP is well maintained and inspected regularly
- Follow manufacturers instructions
- Make sure equipment is levelled
- Always deploy outriggers or stabilisers and use as recommended by manufacturer
- Ensure area around working platform is cordoned off if materials can fall down

4.2.4 Hoist, Cranes and Forklifts

Only qualified and trained personnel shall operate hoist, cranes or forklifts:

Certified Personnel for Forklifts

Main risks when operating hoists and cranes are

- *Falling of load*
- *Getting struck by load*
- *Load hitting other objects*

Prevention measures

- Ensure crane or hoist are inspected and maintained periodically
- Perform a visual inspection before each operation
- Ensure lifting area is clear and prevent access to it
- Hoists and cranes shall not be overloaded
- Only use appropriate material andequipment

4.2.5 Material Handling Equipment

Material handling equipment include all lifting devices made from steel chain, wire rope, metal mesh, natural or synthetic fiber rope, and synthetic web.

Equipment shall comply with according international standards.

- All materials handling equipment has rated capacities that determine the maximum weight the equipment can safely handle and the conditions under which it can handle those weights.
- The equipment-rated capacities shall be displayed on each piece of equipment and shall not be exceeded.
- The supervisor is responsible to select the appropriate material handling device for each activity.
- The operator shall visually inspect the device for damages prior to an activity
- Any damaged or defective device shall be removed from service immediately.

4.2.6 Hot Work Operations

Hot work operations include all activities with ignition sources near flammable material. Examples are brazing, cutting, grinding, and soldering.

Hot works shall be done only by qualified and trained personnel.

Main risks involving hot works are:

- *Fires*
- *Burns*
- *Toxic fumes*

Prevention measures

- All hot works outside of regular contractor workshops and the Mechanical workshop require a hot work permit to ensure necessary safety measures are in place
- Operators should ensure that no flammable material is in work area
- If flammable material or covered flammable material is present in work area a fire guard needs to be present
- Provide suitable fire extinguishing equipment
- Use appropriate equipment and Personal Protective Equipment
- The hot work permit can be downloaded here:

  Hot Work Permit

4.2.7 Lasers

The laser is a device which produces a very intense and very narrow (collimated) beam ofelectromagnetic radiation in the frequency range of 200 nm (nanometers,1 x 10-9 meters) to 1mm.

This radiation is generally in the form of intense visible light.

Lasers are used within the observatories, for example for alignment issues.

Main risks from a laser result from burns to the skin and especially the eye.

All works involving lasers shall only be executed by trained and qualified personnel. LPO has two Laser Safety Officers (LSO); they are responsible for the application of safety measures according to standards and the instruction of personnel working with lasers.

LPO observatory applies American National Standard Institute (ANSI) Z136 series and specifically Z136.1 “Safe Use of Lasers”

4.2.8 Confined Space

Confined spaces are considered any enclosed or partially enclosed space were there is a foreseeable risk of:

- Fire or explosion due to hazardous atmosphere
- Loss of consciousness or asphyxiation arising from gas, fumes or lack of oxygen
- Drowning from an increased level of liquid

These risks might arise in

chambers, trenches, tanks, pipes, sewers, silos, pits

When works in confined space are necessary, a thorough risk assessment shall be done that includes

- Hazards associated with the confined space itself
- Hazards associated with the work to be carried out
- Needs to isolate the confined space to prevent dangers occurring from the outside
- Requirements for emergency rescue

4.2.9 High Altitude (APEX, ALMA, Cerro Armazones)

Within ESO all works that take place at 3,000m or higher are considered High Altitude Works.

Due to the oxygen deprivation in the air human functions are impaired and this might have serious effects on personal health, as well as work performance.

Immediate effects on persons might include:

Headaches, drowsiness, nausea, altered mental state, loss of balance, impaired reason.

To prepare for working in High Altitudes all ESO members of personnel are required an annual High Altitude Medical Exam (HAME).

Contractors and visitors that perform any kind of professional activityalso have to present a high altitude exam or present equivalent documentation from their respective accident insurance.

ESO can not grant any exemptions from this rule for any professional activity.

The particular exam requirements are established together with ESO Human Resource. The specifics can be seen at:

High Altitude Medical Exam

In addition, people should get adjusted to altitude by spending at least one day and night at a level between 2,000 and 3,000m.

ACUTE MOUNTAIN SICKNESS

- Acute Mountain Sickness - AMS is a term applied to a group of symptoms likely to occur in un-acclimatized people who make direct ascents at high altitude. It also occurs in people who partially acclimatize then make an abrupt ascent to a higher altitude.
- High Altitude Pulmonary Edema - HAPE is abnormal fluid accumulation in the lungs resulting from mal-adaptation to altitude. HAPE rarely occurs below 2,500 m.
- High Altitude Cerebral Edema - HACE is swelling of the brain thought to be caused by hypoxia-damage to brain tissue. HACE generally occurs above 3,500 m but has been recorded at 3,100 m.

Weather related risks when working in High Altitude (APEX, ALMA)

Inclement weather can occur in the Chajnantor Plateau area. Volatile weather can exist any time of the year, and as such, contingencies must be made to deal with such events. Inclement weather and natural events that may exist in this area include:

- Earthquakes
- Lightning
- Thunderstorms and high winds
- Heavy snow or ice storms
- Flash floods
- Landslides
- Volcano (The risk is very low - The Lascar is at a safe distance)
- Heat (See Section 5-1)

Prevention measures

- Currently the APEX web page provides a source of weather information for the Chajnantor Plateau.

- During inclement weather, the APEX Station Manager or the APEX Deputy Station Manager will monitor this or similar information regularly and will decide if access to the telescope is possible or if alternately the telescope has to be evacuated.

- It is strongly recommended that each responsible individually monitors weather conditions in the area, as well as news and alerts that may be introduced via internet, radio, or television.

- Members of ESO personnel working at ALMA should refer to additional information provided in the ALMA Safety Manual.

4.2.10 Ergonomics

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working staff.

Ergonomic issues comprise aspects like:

- *the work environment, i.e.*
  - temperature
  - noise
  - lighting
  - vibrations

- *work equipment*
  - hand held tools
  - workstations

- *behaviour*
  - repetitive forceful movements
  - frequent or heavy lifting
  - prolonged awkward positions

Activities associated with any of the mentioned aspects need to be assessed properly to avoid long term effects like Musco-Sceletal-Disorders (MSD) or Work Related Upper Limb Disorders (WRULD)

Prevention measures should include

- Use of ergonomic workstations and equipment
- Means to provide adequate temperatures and lighting at workplaces
- Work activities that increase risk of above mentioned effects should be evaluated in order to:
  - avoid these activities,
  - applying technical measures to reduce effects
  - applying organisational or administrative measures to limit exposure

4.3 General Hazards

General hazards are not limited to work related activities but might also be present in rooms or public areas within the observatories, and thus affect everybody.

4.3.1 Electricity

Usage of electrical equipment is very common not only at workplaces but also in the rooms and during spare time.

Main Risks when dealing with Electricity are:

Electric Shock results in a convulsive response by the nervous system to the passage of electricity through the body

Electrical Burns usually occur on the surface of the skin at points of contact where electricity passes through the body.

Fires can be caused by

- Leakage of current due to poor, damaged, or insufficient isolation.
- Overheating of electrical equipment due to overloading (for example by daisy-chaining, or using multiple outlets)
- Ignition of flammable vapour by electrical equipment that is not operating normally

Prevention measures

- Routinely check electrical appliances and wiring for damages
- Don’t use damaged cables, electrical appliances, outlets, or multiple outlets
- Never touch live currents
- Don’t try to fix electrical appliances unless you are qualified electrician according to definition set in paragraph about Electrical Works
- Do not enter high-voltage areas

4.3.2 Fire

Fires may occur from manifold sources; electrical circuits, combustible and flammable liquids, cooking areas, or a simple cigarette.

Main risks are:

Burns	- depending on severity can result in major injury and/ or death
Suffocation	- caused by inhalation of smoke
Damages	- to equipment and buildings

Prevention measures:

Technical

- All buildings at LPO are equipped with smoke sensors that sound an alarm when activated
- All buildings are equipped with fire extinguishers according to the type of risk involved

Risk Classes with labeling according to U.S. National Fire Protection Association (NFPA) 10 and Norma Chilena (NCh) 934

CLASSES OF FIRES	TYPES OF FIRES	PICTURE SYMBOL
A	Wood, paper, cloth, trash & other ordinary materials.	
B	Gasoline, oil, paint and other flammable liquids.	
C	May be used on fires involving live electrical equipment without danger to the operator.	
D	Combustible metals and combustible metal alloys.	
K	Cooking media (Vegetable or Animal Oils and Fats)	

- Apart from fire extinguishers several locations are equipped with standpipes and hose systems
- Emergency exits are displayed by a sign and should be illuminated appropriately to ensure visibility

- Due to their remote location Paranal and La Silla observatory have an internal Emergency Brigade that will be activated in case of fire
- Brigade members consist of voluntaries among members of personnel and contractors

Procedural

- Smoking and open flames are not permitted in LPO facilities
- Emergency exit routes should be kept free and unobstructed
- All personnel should be trained on the use of fire extinguishers
- Remove combustible material, like package material, crates, etc., as soon as possible from work areas
- Store hazardous material in appropriate containers or cabinets
- Ensure that combustible material is not stored or located next to heating sources

4.3.3 Sun Radiation

Due to its locations in the deserts and the altitude exposure to sun radiation at the observatories in general is very high.

Main Risks:

- Ultraviolet (UV) radiation is a known cause of skin cancer, skin ageing,eye damage, and may affect the immune system.
- Overexposure to the sun might also lead to heat exhaustion and/ or heat stroke mainly from dehydration

Prevention measures

- Don't stay outside too long without proper protection. Look for shades; cover your skin with loose fitting clothes and a hat that also covers the face and the neck.
- Use sunglasses to protect your eyes
- Apply sunscreen to unprotected body parts (recommended SPF 50)
- Drink regular liquids like water or tea

4.3.4 Traffic

Common traffic rules apply to all LPO premises during the day. In the night the right of way changes: pedestrians have to wait until a vehicle has passed.

Reason is that vehicles are not allowed to drive with high beam within the observatory. This makes it difficult to spot people on the street.

(Paragraph does not apply at APEX)

Main risks:

- Getting hit by a car
- Crashing into another car or installations
- Losing control over the car

Prevention measures

- Only drive with a valid driver's license according to**LPO Driving Procedure (AD2)**
- Only use authorized vehicles
- Drive with caution
- Use the seat belt and drive according to speed limits
- Make sure the car is maintained properly and is technical good condition
- Careful when opening doors during high winds
- Pay attention to driving restrictions during bad weather conditions
- Pedestrians shall use flashlights when walking in the dark.

- Vehicles are not allowed to enter the telescope platform after opening of the telescope domes!

- APEX cars are supposed to follow ALMA traffic rules when using access road

4.3.5 Sports

All observatories offer different kind of sports and/or spare time activities.

- Be aware of the altitude and be responsible with your body
- in general there is no supervision
- a health check with your physician is recommended for regular activities

5 Maintenance of Equipment

Maintenance is vital to any facility if it is to operate in a safe and effective manner. Maintenance can be a costly element of facility operations in terms of dollars and impact on operations. It can also be a potential workplace safety issue if not properly addressed.

Before use, any equipment shall be checked visually for damages or changes.

Depending of the type and usage of equipment periodic maintenance is required.

The LPO Safety Office publishes a list of recommended maintenance schedules that are safety related on its website:

Recommended Maintenance Periods

6 Personal Protective Equipment

Personal Protective Equipment (PPE) is an important element in risk prevention. However, PPE shall only be used if technical and/or organizational measures are not effective. Each LPO members of personnel will get a basic set of protective equipment, consisting of:

helmet / safety cap, sunglasses, jacket, safety shoes, as well as lotions to protect skin from radiation.

Provision of appropriate PPE is responsibility of the supervisor. LPO Safety Office assists in selection of appropriate PPE and controls distribution within Paranal.

PPE used at LPO sites shall meet American National Standard Institute (ANSI), European Norm (EN) or equivalent international standards.

7 Hazardous Materials

Handling, transporting and storage of hazardous materials is described in**LPO Hazardous Material Procedure (AD3)**

8 Accident/ Incident Reporting

Any incidents affecting personal health or damage to facilities, equipments and vehicles must be reported in person, via telephone or e-mail to the respective supervisorand the LPO Safety Office, as soon as possible.

Investigation of incidents and accidents is essential in eliminating possible hazards and mitigation of unsafe situations. Incidents will be reviewed by the LPO Safety Office and measures for mitigation recommended.

9 Training

Training is an important component in any organization.

Professional training not only qualifies personnel for their work activity; it also improves safety by understanding the risks that are involved in activities and how to protect against them.

Training can be provided internal or by external organizations.

Emergency Training is intended to prepare LPO on-site personnel for emergency situations. It can be split up in general training for every member of personnel and specialized training for emergency brigade members or individuals.

All trainings have to be requested in advance and authorized by according supervisors.

10 Emergencies

Emergencies are unforeseen situations that impact the operation of the observatory and/or jeopardize life and health of personnel. Emergency situations need to be evaluated before, during, and after the incident in order to introduce proper controls.

The **Emergency Action Plan (AD5)**lists possible emergency situation, responsibilities and necessary actions.

Minor emergencies are coordinated by the Emergency Coordinator; more complex situations require an Emergency Committee which is formed of available management on site.

The procedures for the Emergency Coordinator are outlined in **Emergency Coordinator Procedure (AD4)**

10.1 Emergency Preparedness

Given to the remote locations of the observatories emergency preparedness is very important to all sites.

10.2 Emergency Drills

Emergency drills enable on-site personnel to practice evacuation procedures and emergency personnel to review if procedures are working.

Drills can be unannounced or announced. They will be organized and scheduled from the Safety Office.

The emergency drill schedule will be distributed among Department Heads and Emergecy Brigade members.

11 First Aid

The LPO first aid stations have been established due to the remote location. Purpose is to cover immediate health problems until transfer to further medical treatment is or until recovery if feasible within a couple of days.

Additional tasks are the equipment and inspection of First Aid cabinets and reporting of medical incidents.

The First Aid stations are equipped accordingly and staffed with qualified Chilean paramedics.

The LPO Safety Office is supervising the management of the Policlinics in La Silla and Paranal.

12 Communication

By setting up different means of communications LPO ensures that all levels of personnel are involved in safety matters.

12.1 ESO Safety Commission

In accordance with **ESO Safety Policy and Organisation (AD1)**the commission consists of the Site Safety Engineer Garching, the Site Safety Engineer LPO, the respective Site Safety Responsibles, and memebers of the ESO management nominated by the Director General (DG). Tasks are described in above mentioned document.

12.2 LPO Site Safety Committees

The LPO Site Safety Committee consists of department heads and/or their representatives, representatives of the local union and International Staff Association.

Main tasks are the discussion of proposals, improvements or general safety topics.

The Paranal committee meets every four months while La Silla and APEX committees meet twice a year.

12.3 Safety Briefings

Each member of personnel, contractor, and visiting astronomer who arrives for the first time at LPO sites will get an initial safety briefing to get basic safety information about the location.

Additional briefings related to specific subjects or groups might be set up depending on necessity.

12.4 Safety Awareness

Everybody visiting or working at LPO facilities has to complete a mandatory electronic safety induction according to the respective site.

Members of personnel/ contractors will get an additional introductory safety briefing from the Safety Engineer to become familiar with possible risks on the site.

Furthermore the Safety Office publishes useful information on its Safety Board or its website at LPO Safety Website.