



CTA-South Infrastructure & IKC TEAMs Support

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1 INTRODUCTION

1.1 SCOPE

The Cherenkov Telescope Array is an array of Imaging Atmospheric Cherenkov Telescopes (IACT) used to detect high energy gamma-ray being constructed at two separate sites, CTA North and CTA South and constituting the CTA Observatory. CTA will be composed by telescope of tree different sizes, each one dedicated to a specific energy range. During the first, construction, phase of the project CTA South will host telescopes of two sizes, the Medium Sized Telescope (MST) and the Small Sized Telescope (SST).

This document provides information regarding the availability of the infrastructure at the CTA South Site at the planned time of arrival of the Telescope Teams in charge of the assembly, commissioning and testing of the telescopes

It will detail the service expected to be available on site as provided by CTAO and/or by ESO as set forth in the CTA South hosting agreement. It is noted that means or services to the IKC teams may be furnished by ESO, but only upon request by CTAO to ESO.

NOTES:

Being neither the exact time of arrival of the IKC teams nor the detailed construction schedule known yet a detailed status of CTA-S site cannot be provided as part of this document. With the evolving planning on both sides refinement of this document may be needed.

At the time of the first issue of this document the detailed definition of the CTA South has started, but many aspects are still to be defined. Therefore this document will be updated regularly when relevant information will be available.

1.2 DEFINITIONS AND CONVENTIONS

1.2.1 Abbreviations & Acronyms

Abbreviation	Definition
ADXX	Applicable Document XX
ACADA	Array Control And Data Acquisition.
CTA	Cherenkov Telescope Array
CTAO	Cherenkov Telescope Array Observatory
CTA-S	CTA - South
DPPS	Data Protection and Preservation System
DUPS	Dynamic Uninterruptable Power Supply
ESO	European Southern Observatory
ICD	Interface Control Document

IKC	In-Kind Contribution
LST	Large Sized Telescope
MST	Medium Sized Telescope
SST	Small Sized Telescope
TBC	To Be Confirmed
TBD	To Be Determined

1.2.2 Definitions

Term	Definition
CTAO	For the purpose of this document CTAO means the entity monitoring the delivery of the telescopes to CTA - South as set forth in the associated IKC agreement.
Site	Site means CTA - South Site within the territory of ESO where the CTA South Observatory will be constructed and operated in the Southern hemisphere.
Infrastructure	Means the support facilities, the installations and services required to construct and operate the Telescope Array, such as access roads, power distribution system, IT equipment and network operations and maintenance facilities, amongst others.
Array site	Array site" means the area where the telescope Array and its specific Infrastructure are deployed; many elements of Infrastructure will be located outside the Array site.
Contractors	Contractors are external companies which either contracted by CTAO or by the IKC teams for executing certain construction activities or specific services.
IKC Teams / Telescope teams	IKC Teams are the consortia responsible for the delivery, the construction and the commissioning of In-Kind elements of the Array (both SW and HW). This includes the Telescope Teams, which are the IKC consortia responsible for the delivery, the construction, and the commissioning of telescopes of the Array.
Telescope	Telescopes are the units which form the scientific instrument for the observation of the Cherenkov light. They consist of the telescope structure and the camera

2 APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of the specification shall be considered a superseding requirement.

2.1 GENERAL CTA DOCUMENTS

No.	Title	Doc no	Issue / Rev.
AD01	Interconnecting road layout	<u>To be issued</u>	
AD02	Rules and Regulations for 3 rd parties working on the CTA-S site	To be issued	
AD03	CTA-S Site Safety Manual	To be issued	
AD04	CTA-S Site Access Policy	To be issued	

2.2 REFERENCE DOCUMENTS

The following documents provide accessory background information

No.	Title	Doc no	Issue / Rev.
RD01	Shipping instructions	In progress	

3 CTA SOUTH SITE OVERVIEW

3.1 GENERAL

The site of the CTA South Array is located on the land of the European Southern Observatory in Chile, close to the ESO Paranal Observatory.

3.2 LOCATION AND DESCRIPTIONS

The location of the CTA South is on the territory of the European Southern Observatory at the Paranal observatory. The South site is described in the picture below.

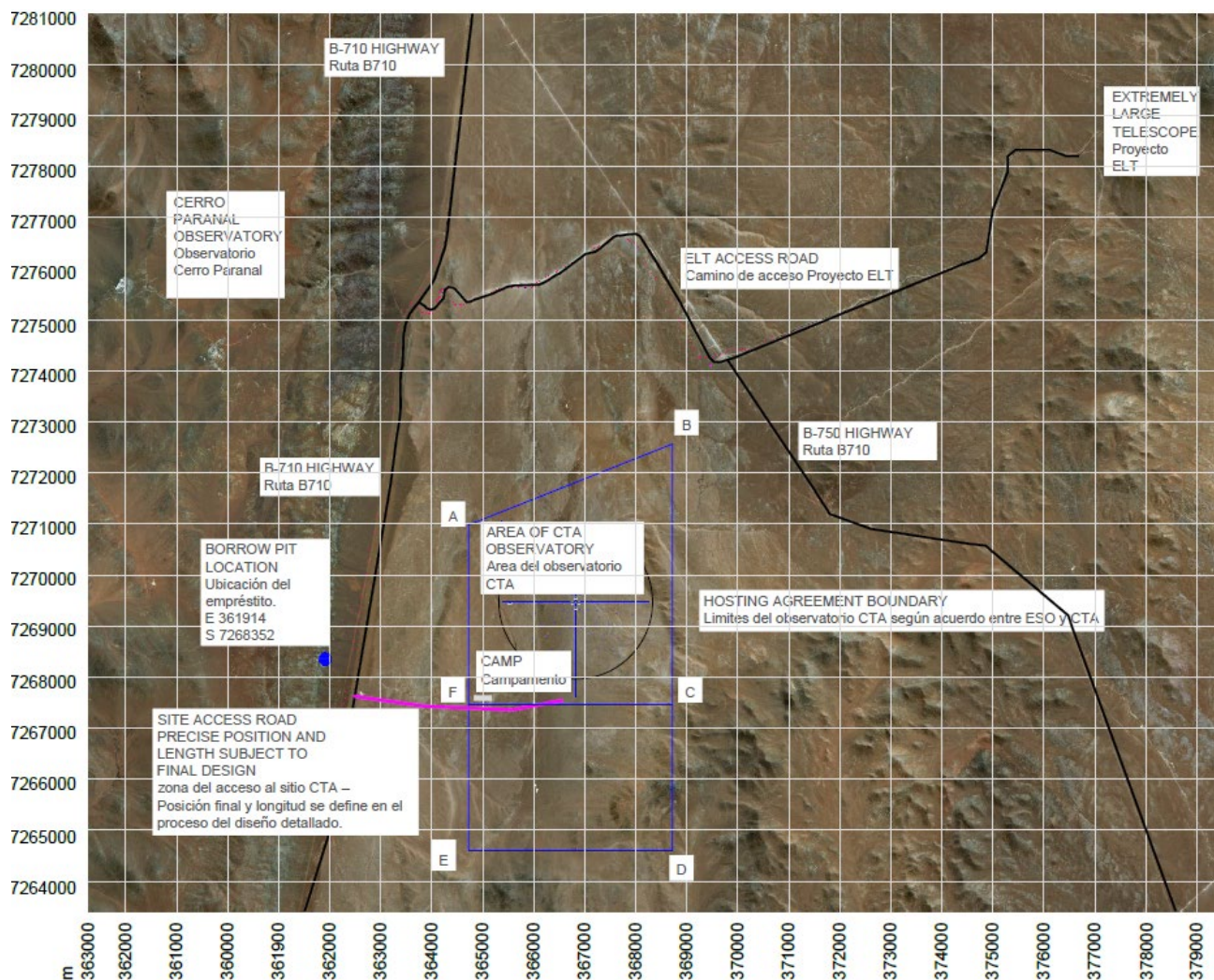


Figure 1: view of the extension and location of the CTA South site

The blue area describes the overall site extension of the CTA South site.

For the purpose of this document the elements of interest are:

- The Array Area delimited in the picture by the Circular perimeter
- The Infrastructure Area, which is the area where the camp is erected and where specific maintenance and operation facilities as described in this document will be located.

The coordinates of the corners of the CTA South Site in UTM WGS84 zone area the following:

POINT	EAST m	SOUTH m
A	364722	7270981
B	368722	7272576
C	368722	7267466
D	368722	7264166
E	364722	7264166
F	364722	7267466

3.3 ACCESS TO THE CTA SOUTH SITE

The CTA South Site will be accessed from the public road B710 with an access road constructed by CTAO. The road will have standard characteristics and comply with the *Manual de Carreteras* issued by Ministerio de Obras Publicas (MOP), Chile.

The main characteristics are:

- Length between the B710 and the entrance gate: (being designed), typically about 4 Km
- Two lanes
- Total Width: 7.3 m
- Curvature radius suitable for articulated trucks of up to 20m length
- Maximum slope < 10 %
- Surface finish: Asphalt pavement (type Cape seal)
- Load carrying capability: standard truck axle load, as permitted on Chilean public roads
- Transport height limitation: Because of the 66 kV overhead line, which intersects with the site access road, the height is limited to a standard truck-ISO container configuration (4m), special transports with larger total height will need a request and authorization by CTAO before initiating the transport

Access to the CTA South shall be limited to the use of the access road. Access outside the road is strictly prohibited.

3.3.1 Access Gate

The entrance to the CTA South site will be equipped with a gate and an access control area. From the access gate at the Infrastructure Area the access road will continue to the Array area. The layout of the road from

the access gate to the Array operation shown in figure 1 is preliminary and it will be optimized for cost and geographical constraints.

The access will be controlled by a security service contractor contracted by CTAO. Access to the site is restricted and must be requested at least 48h prior to arrival on site to CTAO, following the CTA-S site Access Policy, see AD04. This allows for the preparation of receiving of goods and to cover aspects associated to board and lodging and other services. All persons entering the site will receive a badge which must be visible during the stay and be returned when leaving the site. Detail access instructions will be provided in AD04.

3.4 ARRAY AREA

3.4.1 Access and Fencing

No external fencing will be provided encompassing the whole CTA South.

For the Array area a perimeter fence will be erected for security and safety reasons. An access gate to the Array area will be installed, and access will be regulated. The access control to the Array area will vary for the different construction and integration phases with the following options:

- No control: Gate will be opened in the morning and closed in the evening, everybody must be out of the fenced area when the gate is closed.
- Automated Access Control via badge
- Small gate house with guard controlling access

The access to the telescope construction area will be limited to day time, independent from the access control system.

The final Array area access control scheme is under development, and will be presented in a future version of this document.

The security provided by the fence has to be considered moderate. This means that it will not prevent determined theft. For this reason precautions of not leaving valuables, specific equipment and easily removable items at the construction site must be formulated, propagated through the IKC Teams, and generally adhered to.

Considering that there will be no individual permanent fences around the telescopes, special procedures will need to be developed and applied for the telescope testing and commissioning. This shall be covered by the Telescope Teams site safety manual and associated applicable procedures.

3.4.2 Telescope foundations

The precise location of the telescope foundations within the array is being defined at the time of writing, being this associated to the scientific performance. As soon as the final definition will be known the needed information will be implemented in a new release of this document, with coordinates provided in Annex A.

CTA will construct:

- 40 Small Sized Telescope foundations
- 14 Medium Sized Telescope foundations
- No telescope foundation will be constructed for the Large Sized Telescopes. However in view of the expected future extension of the array with 4 LSTs, excavation works associated to the later construction of the foundations will be executed to avoid dust production during operation of the

array. The excavation area will be protected by gravel in order to avoid dust. The portion of the interconnection road to the 4 excavated LST areas will be blocked by barriers.

The exact coordinates of the telescope foundations which will be constructed are given in Annex A with reference to the Azimuth axis (central axis) of the individual telescopes.

The telescope foundations will be built according to the agreed design and valid ICD's as reported in the relevant IKC agreements.

The area around the telescope required for construction and maintenance will be compacted and covered with gravel. Gravel might be put in place after the construction of the observatory, or before if needed (example: prior to optics/camera installation)

3.4.3 Array Interconnection road

The individual telescope locations can be accessed by an interconnecting road. The design of the interconnecting road is provided in AD01 (to be issued).

The interconnecting road will be paved with asphalt single lane type. The other characteristics will be the same as for the access road. Leaving the interconnecting road is not allowed for any reason to avoid accidents, dust generation, and the risk of interference with buried communication and power line.

From the interconnection road flat, leveled, and compacted access to the telescope foundation area will be provided. This access might not be paved during the construction phase.

3.5 LAYDOWN AREA

A limited surface laydown area for use by the Telescope Team may be prepared inside the Array Operation Site perimeter. This will allow to centralize the transport and storage of transport containers and possibly a workshop or other equipment by the Telescope Teams and minimize the dust production by limiting distributed local areas at each telescope foundation.

The need of laydown area, its location and its dimension will be discussed with the telescope Teams. Some characteristics is as below:

- Total dimensions: TBD m2, (if needed with terraces)
- Levelled with a typical slope < 2%
- Compacted to a bearing capacity allowing the transport of 40 feet containers on standard truck.
- Allocation space assigned separately for MST and SST telescopes
- For small workshop installations a 400V distribution will be available to connect electrical tools and equipment.

3.5.1 Storage of flammable and Hazardous material

There will not be a centralized location for storage of flammable and hazardous material. In case such material is used (paint, chemicals, fuel...) a dedicated area with a fence and fire extinguishing provisions will have to be prepared by the Telescope Teams .

3.6 POWER DISTRIBUTION

3.6.1 Permanent Power distribution

As baseline during construction of the telescopes the permanent power distribution system will be in place.

The telescope foundations will be equipped with a 400V three-phase connection to a nearby electrical substation via underground cable, as detailed in the corresponding ICDs. The power distribution will be of TN-S type. The substations, which consist of a step down transformer 10/0.4KV and a switchgear will have breakers for each telescope foundation. These breakers can be locked and secured against unauthorized switching. Access to the substations will be for authorized persons only.

At the foundations there will be at least one connection point to the earthing network. Once the telescope is installed this will establish a permanent connection between earthing grid and telescope, but can also be used for construction equipment, if necessary.

Given the fact that the main power supply is connected to a Dynamic UPS (DUPS) or also called Power Conditioning system, in general terms the supply of the telescopes will be uninterrupted and stable. However it must be considered that:

- During the commissioning phase of the power system instabilities and outages shall be considered, the latter ones announced as much as possible in advance
- During exceptional operation conditions the operation of telescopes will be restricted, as the DUPS will not be 100% redundant.

Detail of the I/F will be described in the associated Interface Control Document.

3.7 FACILITIES

3.7.1 Operations Building

The Operation Building design is largely to be defined at this stage. Nevertheless it is expected that it will have an extension of app. 700sqm and be equipped with on-site control room, computer room, offices kitchen and dining facilities, bathrooms and first aid station.

The operations building will not be constructed before construction of the telescopes has started. Therefore it shall not be taken into account by the IKC and Telescope Groups during the deployment of the telescopes.

Specific services which in operation will be located inside the operation building will be administered during the construction of the array as detailed under the Section 4.8.

3.7.2 Technical Building

The Technical Building will have a surface of app 1000sqm, allocated as it follows:

- | | |
|---------------------------|---|
| • Warehouse | 400sqm |
| • Workshop | 150sqm |
| • Assembly area | 400sqm |
| • Camera workshop | 50sqm |
| • Telescope assembly hall | size TBD with overhead bridge crane of 10ton. |

Note: The camera workshop will not have a specific ISO Cleanliness class, but provisions will be made to keep this area as dust free as reasonably possible.

Note: A mirror Coating facility is neither funded nor planned at the time of writing.

3.8 IT INFRASTRUCTURE

3.8.1 Datacenter

For operation of the array a Datacenter is foreseen inside the operations building. In its final configuration the Datacenter will be equipped with the Datacenter patch panel connecting the optical fibers from the individual telescopes to the camera servers. The Control Room or (control hut in the initial phase, see below), the IPS system, the environmental monitoring system and the Atmospheric Characterization System will also connect to the patch panel (TBD Array Calibration System). The Datacenter will also contain a central switch and the ACADA and DPPS nodes, in addition to various other IT infrastructure.

During the deployment phase of the telescopes the building may not be completed or sufficiently equipped for hosting the final Datacenter. In this case the possibility to install a provisional Datacenter assembled in a container, for later migration of the components inside the computer room of the technical building will be studied by CTAO. Such container may be located in proximity of the operations building location for easy connection switching of the optical fibers between the temporary solution and the permanent Datacenter from the telescopes and to the environmental monitoring system.

3.8.2 Control room

In its definitive configuration the operations building will host the Array control room.

During the deployment and commissioning phase of the telescopes the control room may not be available and in any case should not be used. The commissioning and testing of the telescope demands a control in proximity of the telescope itself. To this purpose the telescope groups shall foresee one or more movable Control hut(s) to be located outside the movement envelope of the telescopes. The control hut will be connected to the Interface Cabinet at the telescope foundation.

3.8.3 Fibre Optics Network

3.8.3.1 Array network

This is constituted by the optical fibers connecting the technical building to the telescopes, the environmental station, and the site characterization system. The fibers will be distributed inside buried conduits.

The array network fibres are not part of the site infrastructure, but the computing Work Package.

3.8.3.2 Communication to the outside of the array

From the data center an optical fibers connection to the exterior of the South site will be established and available during the deployment of the telescopes for communication to the outside world.

The IKC teams will receive Internet on site for their office needs and the interface for the telescope data is the computer room or the provisional Datacenter container.

3.9 MOBILE HANDLING AND ACCESS EQUIPMENT

3.9.1 Cranes and forklift and manlift

CTA plans to buy specific equipment which will be used for operation. Such equipment can be also used on a shared and best effort principle during construction and deployment of the telescopes.

The equipment will be either operated by CTAO operator based on operator cost reimbursement, or operated by IKC team members certified as operator with a valid license.

The following handling means may be made available on site:

- Heavy duty crane truck 30tons at 3m (TBC)
- Forklift 5 tons
- Forklift 2 tons
- No. 2 Manlifts for assembly and access for maintenance and LRU substitution

3.9.2 Trucks

A standard 10 ton truck will be available on site for transport of telescope components.

3.9.3 Restrictions

As different teams might be working at the same time on site, the occupation of the CTAO equipment will not always be possible on demand, but needs to be coordinated between the teams. CTAO will in any case authorize the usage and assign the equipment.

Heavy equipment, such as shipping containers or very heavy parts cannot be moved with CTAO handling equipment and the Telescope Teams will need to organize such, also site internal, transports and relocations by themselves.

3.10 ACCOMMODATION AND SERVICES FOR IKC TEAMS / TELESCOPE TEAMS PERSONNEL

3.10.1 Construction camp

A construction camp will be available during the construction phase and deployment of the telescopes. The camp will be equipped with board and lodging facilities as it follows:

- **Accommodation for IKC personnel**

Year of integration activities	1	2	3
IKC total	29	29	35
Telescopes MST	12	12	15
Telescopes SST	12	12	15
Other IKC	5	5	5

- **Office Space**

A certain number of offices will be made available to the IKCs. The exact assignment will be defined at a later stage.

3.11 SERVICES - GENERAL

This Section details the provision of specific services by CTAO to the telescope groups

3.11.1 General Regulations

Specific rules for receiving and hosting personnel on site will be established in due time and recorded in specific documents. This will, amongst others, include regulations related to safety and access on site, as defined in AD02, AD03, and AD04.

3.11.2 Supply of Electrical Power

Electrical power in the form of 400V, three-phases will be available at each telescope station. Such power can be used for construction and commissioning of the telescopes. The electrical power will be provided free of charge to the IKC Teams.

3.11.1 Accommodation

Board and lodging services will be provided by CTAO at cost reimbursement basis. For the use of the accommodation a flat service fee (night , meals) will be charged to the IKC groups and their contractors. The exact conditions will be specified in the IKC agreement between CTAO and the in Kind contributors.

3.11.2 Potable water

Potable water will be put at disposal of the IKC teams and their Contractors.

3.11.3 Fire fighting

During the construction period there will not be a fire brigade at the CTAO South. The ESO fire brigade, stationed at Paranal will be available but it is likely not be located directly at the site.

Hand extinguishers will be provided by CTAO in proximity of the telescopes during the assembly period.

3.11.4 First Aid facilities

A first aid facility will be available on site according to Chilean regulations. This first Aid facilities will provide basic services free of charge. Ambulance services will be available by means of an agreement with ESO Paranal.

3.11.5 Communication

Communication and internet services will be available on site by means of a Chilean Provider. Voice over IP will be available. However each IKC team must organize their telephone service with a local provider.

3.11.6 Vehicles

No vehicle will be provided to the IKC Teams during the deployment and commissioning phase. The IKC Teams shall organize their own rental or alternative vehicle logistics.

3.11.7 Fuel for vehicles

As baseline no fuel will be provided for vehicles as part of the CTAO services.

It may at a later moment be discussed, if a fuel station can be made available on site. In this case the IKC teams will have access to the services, in any case on a cost reimbursement basis.

3.11.8 Sewage facilities

Sewage facility at the construction camp are part of accommodation services.

Given the distance between the array site and the Construction camp, CTAO plans to make available a few portable toilets at labor intensive assembly places.

3.11.9 Laundry

Telescope Teams staff will have access to the same laundry facilities as CTAO staff, which will either be the availability of the corresponding washing and drying machines or a laundry service of the facilities operator.

4 LOGISTICS OF SHIPMENT TO THE SITE

4.1 GENERAL

The telescopes and any other element to be shipped to the site by the IKC teams shall be sent from the place of origin to the CTAO South site under the full responsibility of the respective IKC Team. Also the unloading on site shall be included in this process.

The teams shall organize the unloading of their goods (preferably ISO containers) at the CTA-South site independently from CTAO.

4.2 LOGISTICS ADMINISTRATION

The exact administrative process will be defined, once the legal framework of the ERIC is in place. As a general rule ESO will be responsible for the import formalities and no import duties will have to be paid, when bringing the telescopes to Chile as long as the instructions which will be provided are strictly followed.

To facilitate this process the necessary documentation according to Annex F: Routing and Packing of the ESO CTA Hosting agreement and other administrative instruction provided by ESO will be made available to the IKC teams via the CTAO logistics officer in Bologna in due time. Specific instructions will be prepared (RD01) and discussed with the IKC teams.

Administrative fees shall be reimbursed by the IKC and Telescope Teams.

Note: The import clearance time will be largely influenced by the proper and timely handling and submittal of the necessary paperwork as it will be detailed in RD01. The clearance process nevertheless may take a few weeks, and it is largely out of the control of CTAO.

It is reminded that equipment, including transport container cannot be sold in Chile and if not part of the delivery to CTAO will have to be re-exported in due time.

4.3 STORAGE ON SITE

Storage of the shipping containers upon delivery on site will be coordinated between CTAO and the IKC Teams.

5 RULES – LIMITATIONS - SAFETY

The CTA South will be constructed and erected on ESO land. For this reason specific rules and limitations will apply. CTAO will issue a specific document containing all rules applying to the site, AD02.

In general CTAO is responsible for guaranteeing to ESO that IKC teams and contractors operating on ESO land will fully abide to Chilean labor regulations, including social security, when applicable. Regular inspection of employment records in case of employment of Chilean labor will be performed. More details will be available in the document AD02.

At short distance ESO will operate during night hours optical and Infrared telescopes. For this reasons the rules will specify that no construction work will be allowed during the night, cars will have to travel with dimmed light, and light pollution will have to be avoided to the highest reasonable extent.

Additionally safety will be subject to ESO safety rules.

As a consequence of the above, as baseline CTAO will provide to the IKC and Telescope Teams as a minimum:

- **Rules and Regulations for IKC personnel and contractors working at CTAO South Site (AD02)**
- **Site Safety Manual (AD03)**

These documents will be referenced in the In-Kind Contribution agreement.

5.1 CTAO SITE SAFETY

CTAO will have a site safety engineer in place, who will have the authority of controlling and enforcing the site safety regulations. The site safety engineer has the right to inspect all work spaces at any time to assure a safe work environment.

The IKC and Telescope Teams shall designate a Site Safety responsible with the task to control adherence to the safety rules, to plan and coordinate any heavy lifting or dangerous activity, and to report to the CTAO safety Engineer.

In all cases in which the IKCs plan to perform work in CTAO-S common area, like the camp technical area, the CTAO work permit system must be applied where necessary.

5.2 INSURANCES

CTAO will contract an All Risk Construction Insurance. The insurance company may require specific tasks and provisions, which are beyond of what is being defined by CTAO. To assure the insurance protection, it is mandatory for all parties to respect such special requirements.

All IKCs must assure that their subcontractors have the legally required insurances for their staff up to date and with the necessary coverage. CTAO does not assume any responsibility or control in this area.

6 ANNEX A: TELESCOPE COORDINATES

TBD