VLT PROGRAMME

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

Very Large Telescope

Requirements for Visitor Instruments at the VLT UT3 Visitor Focus

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Change Record

Issue	Date	Section/Paragraph Affected	Reason for Change Remarks
1D1	20.03.2006	all	new document, merged from Requirements for Sci. Instr. and the Cassegrain Visitor doc
1D2	03.2006	3.9, 3.23	numbering changed, for subsequent subsections too
		many	consistent marking of mandatory requirements and important information
1D3	05.2007	2.3.6	new description of rotator range
		2.1.6	new section on operations
		2.4	standalone option introduced. Partly compliant options removed
		2.4.4, 2.4.5, 2.4.6	modifications referring to the fibres connecting control room and visitor focus allowing standalone option (2.4)
		2.6.1	more info on integration space in the UT enclusure
		3.10	requirements relaxed
		3.11	shortened
		3.15	removed requirement for protective cover
		3.17.1	relaxed requirement on information about local interlock condition
		3.17.2	relaxed requirements towards cable wrap
		3.18	reduced to CAS
		3.19	no spare parts supplied by ESO
		3.20	removed section on recommended el. components
		3.20	drastically shortened
		3.21	relaxed requirements
		4	more details concerning LN2 use
			removed justification for having VIs as single units
		10.1, 10.2	updated
		2.4.1	new section
		8	shortened but made a bit more precise
		3.12	section on secondary guiding removed
1D4	07.2007	4	specs for the LN2 tank
		3.20	another sw doc for fully compliant case
		8.3	introduced software commissioning
		2.4.5	spec for direct fibre links; description of UT console
1D5	10.08.2007	A	added ADWG-C3 to table7
1D6	04.09.2007		some formatting
1	27.09.2007	1.3	removed section on policies

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1 Scope

1.1 A Visitor Instrument

A visitor instrument is defined as an instrument that shall be attached to the VLT but not operated by ESO. Such an instrument may avoid some of the requirements placed on normal ESO instrumentation. It is the aim of this document to specify the interfaces and requirements that such an instrument will have to meet in order to successfully operate at the Unit telescopes of the VLT.
The points below are further elaborated upon within the document. However, they are explicitly mentioned here to emphasize the importance that ESO places upon these issues.

1. Paranal is located in a seismically active area. Provisions have to be made such that the instrument is secure in case of earthquake at all times including the times of mounting and dismounting. The safety of the personnel and equipment has to be assured.

2. No system attached to the VLT may transmit vibrations to the telescope systems such that it may interfere with the use of the telescope in its interferometric mode.

3. No system attached to the VLT may interfere with the Local Area Network configuration or permissions. Visitor instruments must comply with the observatory rules for connectivity.

4. No system attached to the VLT may produce electromagnetic interference outside the ESO specifications.

1.2 General

This document describes the minimum requirements for a visitor instrument to be successfully mounted at the Visitor Focus of Unit Telescope 3 of the VLT. The document is a subset of the VLT requirements for Scientific instruments on the VLT Unit Telescopes (VLT-SPE-ESO-10000-2723 issue 1) with some additional explanations with respect to visitor instrumentation.

- Items in **bold font are mandatory requirements**,

- items in this font are of major significance.

Issues regarding the safety at the VLT, mechanical and electrical interfaces, network interfaces and environmental impact (e.g. electromagnetic interference, mechanical/vibrational interference with VLTI) are of paramount importance to the operation of the VLT facility and the security of the personnel and cannot be violated irrespective of the status of the instrument. ESO reserves the right to request an acceptance test in Europe where the instrument shall be demonstrated to be safe.
This document also contains general information on the design of the VLT, the infrastructure at the Paranal Observatory, and on the various interfaces between the Observatory and Visitor Instruments (VI) installed at the Visitor Focus of the VLT. Such general information should be used by prospective instrument builders to optimise their designs and interactions with the facility.
Although this document has been created with great care it is strongly advised to double-check with the ESO contact person all necessary details before designing critical items.

1.3 Change procedures and document hierarchy

All VLT VIs shall conform to the mandatory requirements contained in this document, in the Applicable Documents listed in section 10.1 and to the Applicable Drawings listed in Appendix A. Deviations from the applicable documents and requirements contained herein have to be approved in writing by ESO, following the VLT Change Request or Request For Waiver procedures.

2 The Very Large Telescope Project

2.1 Introduction

In this section we describe the overall VLT system, including operational parameters and descriptions.

2.1.1 VLT Concept

The general concept of the Very Large Telescope and its principal performance goals are given in RD[7]. The observatory has the following main elements:

- four 8-metre diameter telescopes with their enclosures, each with two Nasmyth foci, a Cassegrain focus and a coudé focus
- an interferometer and its supporting auxiliary telescopes
- optical and infrared instrumentation
- control and communication systems to support both service mode and visitor mode observing
- a 2.6m VLT Survey Telescope (VST)
- a 4m Visible and Infrared Survey Telescope for Astronomy (VISTA)
- observatory infrastructure for technical support and for the accommodation of personnel.

A more exhaustive description is given in RD[7].
The fact that the Unit Telescopes are also part of the VLT Interferometer is in several cases the reason for various requirements towards visitor instruments.
Technical support for visitor instrumentation shall be, a priori, limited to supervision and assistance with mounting and dismounting the instrument on the telescope and connecting the instrumentation computer facilities to the VLT LAN.
It is explicitly not permitted that the instrument team attaches any device to the VLT system without prior approval. Changes in the network configuration cannot be made by the visitor instrument team. **Specifically the instrument team must not change any IP address within their instrument nor attach/detach any cabling that connects the instrument to the VLT LAN**. Such modifications can only be made by authorized ESO staff or persons authorized by ESO.
It is explicitly not permitted that the instrument weight and its hardware configuration be modified after the instrument is mounted without prior agreement with Paranal engineering[1].

[1]For example removing an electronic rack from the instrument requires prior approval of ESO Paranal engineering staff as it could modify the balance of the instrument rotator.

2.1.2 VLT location

The Very Large Telescope is located on Cerro Paranal in northern Chile, at a distance of 130 km from the city of Antofagasta, at an altitude of 2635 m above sea level. Access to the observatory is from the (paved) Panamericana via 70 km of unpaved road. Width of the road is 6 m, load width ≤12 m and gradient ≤12%.
The coordinates of the telescopes are listed in table 1.

Telescope		Latitude	Longitude
Antu	UT1	-24° 37′ 33″	70° 24′ 12″
Kueyen	UT2	-24° 37′ 31″	70° 24′ 11″
Melipal	**UT3**	**-24° 37′ 30″**	**70° 24′ 10″**
Yepun	UT4	-24° 37′ 31′’	70° 24′ 08″

Table 1: Location of the four VLT Unit Telescopes. The Visitor Focus is Nasmyth focus A on Melipal.

2.1.3 Environmental and observing conditions at Paranal

Information on the environmental conditions on Paranal is given in AD[1].
The statistical distribution of the seeing (500 nm) at zenith on Paranal, from data collected between VLT-Antu First Light (May 1998) and August 2007, is shown in Figure 1. Seeing is reconstructed from Differential Image Motion Monitor (DIMM) measurements taken 6 m above ground at 500 nm and at zenith. VLT science images have shown that seeing at the UTs limited by the atmosphere is about 10% better than simultaneous DIMM estimates. More information on current conditions is available via the Paranal Astroclimatology web pages.

2.1.4 VLT site

The Paranal Observatory comprises three main locations: the Telescope Area at the summit, the “NTT Peak” with VISTA, and the Base Camp with the Residencia and Maintenance Areas. Base Camp and Telescope Area are separated by a distance of 3.4 km. The Telescope Area contains mainly the telescopes, the combined focus and interferometric laboratories, service laboratories and the Control Building.
The plan view of the Telescope Area of the observatory is shown in Figure 2.

2.1.5 Site infrastructure

The main facilities that are available at the Paranal Observatory are as follows:

1. Telescope Area:
   (a) The four Unit Telescopes and their enclosures
   (b) VLT Interferometer (VLTI) with auxiliary telescopes which feed the interferometric laboratory
   (c) The VLT Survey Telescope (VST)
   (d) The Control Building, separated from the telescope enclosures, with
      - Optical and electronics laboratories
      - Laboratory for instrument integration and tests (section 2.6.1)

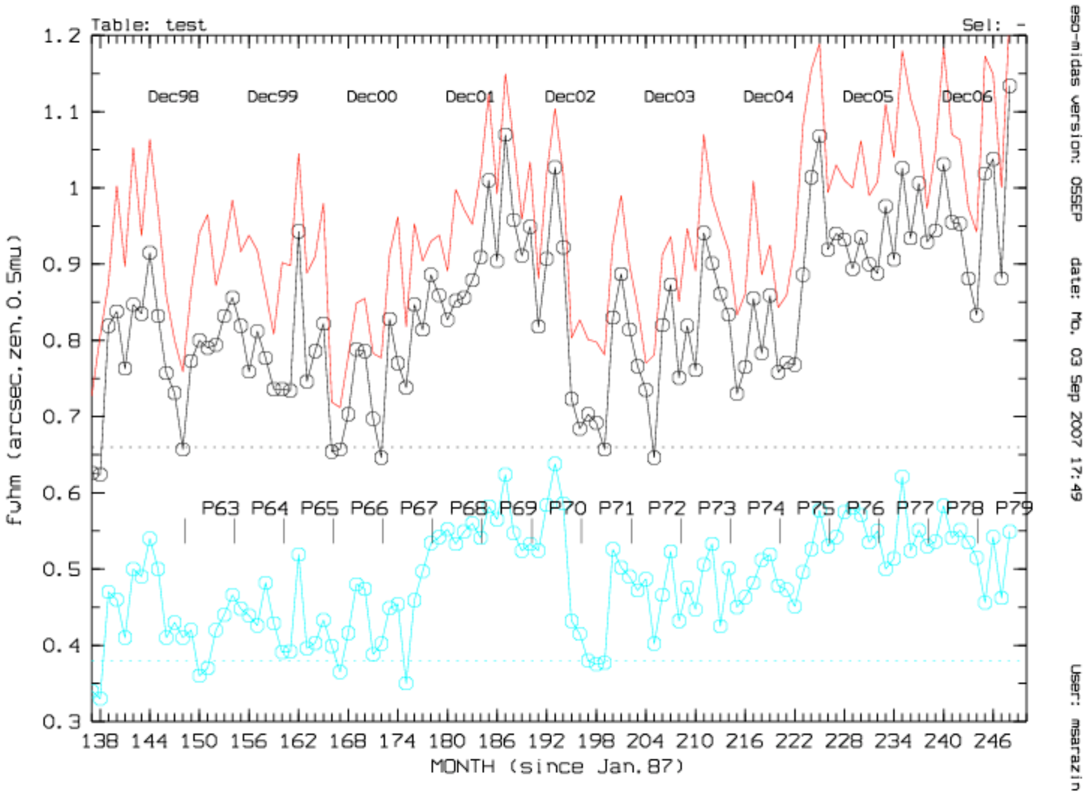

Figure 1: Statistical seeing distribution at Paranal since UT1 First Light. From top: monthly average (red, no symbol), monthly median (black, circles), 1989-1995 median=0.66″ (dashed black line), monthly 5 percentile (blue, circles), 1989-1995 5 percentile=0.38″ (dashed blue line). See text.

(e) Time Reference System and Astronomical Site Monitors (section 2.5.2)

(f) Facilities for the supply of electrical power, compressed air and cooling liquid, telecommunications facilities

2. Maintenance Area:

   (a) Mirror maintenance facility

   (b) Auxiliary Telescope Hall

   (c) Warehouse and storage facilities

   (d) Facilities for the storage of liquid nitrogen. No provisions are made for the supply of liquid Helium, and its use is considered incompatible with operations of VLT science instruments.

3. Residencia:

   (a) Accommodation for site personnel and visitors (visiting astronomers, instrument teams); in case the Residencia's capacity is exhausted visitors will have to be transferred to containers.

   (b) Restaurant and recreational facilities

4. General services:

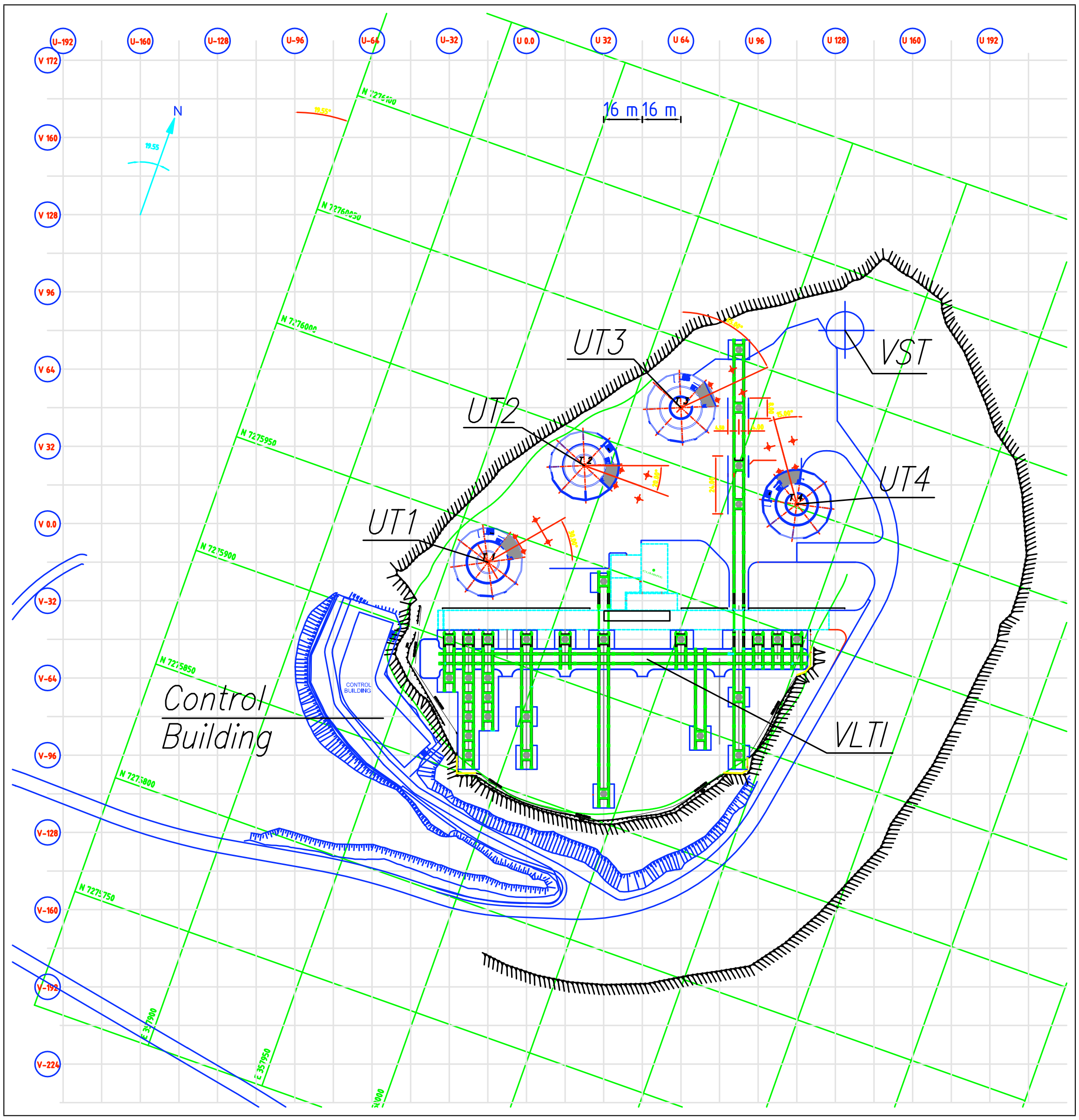

Figure 2: Plan of the Telescope Area of the Paranal Observatory

(a) On-site technical personnel. The use of ESO technical staff to service a visitor instrument (e.g. refill LN2) requires prior agreement between the visitor instrument team and ESO.

(b) Standard vehicles for the handling of equipment and transportation of personnel (section 2.6.2). No automatic allocation of vehicles to a visitor instrument team should be assumed. Car pooling is the norm on Paranal.

2.1.6 VLT operations

This section gives a short overview of the standard way of operating the VLT, with particular considerations of VIs.
All operations are controlled from the control room which is located in the Control Building in the Telescope Area near the top of Cerro Paranal.
For each UT there is a standard set of consoles for:

- telescope control
- instrument control
- off-line data reduction
- environmental information (temperature, wind, seeing etc.).

The way of operating a Visitor Instrument depends on the degree of compliance with the VLT software (see section 2.4): Fully compliant instruments may use P2PP (the Phase 2 Proposal Preparation software), templates and the VLT Data Flow System (DFS), standalone systems need manual input of co-ordinates on the telescope console and have to use their own data acquisition and storage. For details see section 2.4.1.
Calibrations are done during daytime. Night-time calibrations are not permitted.
Access to the Telescope Area of Paranal is unrestricted during daytime. Telescope and instrument access needs authorisation by the UT manager who co-ordinates the various activities at the telescope (science activities like calibrations, maintenance, commissioning etc.). It is allowed by default only during daytime. Any regular or planned maintenance or intervention shall be done during daytime.
Night-time access to the telescope is restricted to urgent cases (crucial malfunction, emergencies). It normally also needs UT manager authorisation. Night-time car traffic at the observatory should be kept at a minimum and is subject to special restrictions.

2.2 The Unit Telescopes

The four Unit Telescopes (UT1-4) are of identical design. Drawings of the telescope structure, indicating the main features, are shown in figures 3 and 4.

2.2.1 VLT Optics

Each VLT Unit Telescope has two Nasmyth foci, a Cassegrain and a coudé focus. In addition, the beams from the four Unit Telescopes can be combined in the coherent (interferometric) focus.
The VLT Visitor Focus is the Nasmyth-A focus of Melipal (UT3).
The most important nominal optical design data of the Nasmyth focus are given in table 2.
The optical design of an instrument shall use the values given in RD[8] where the optical design parameters for the UTs are given. All VLT mirrors have been manufactured within these specifications.

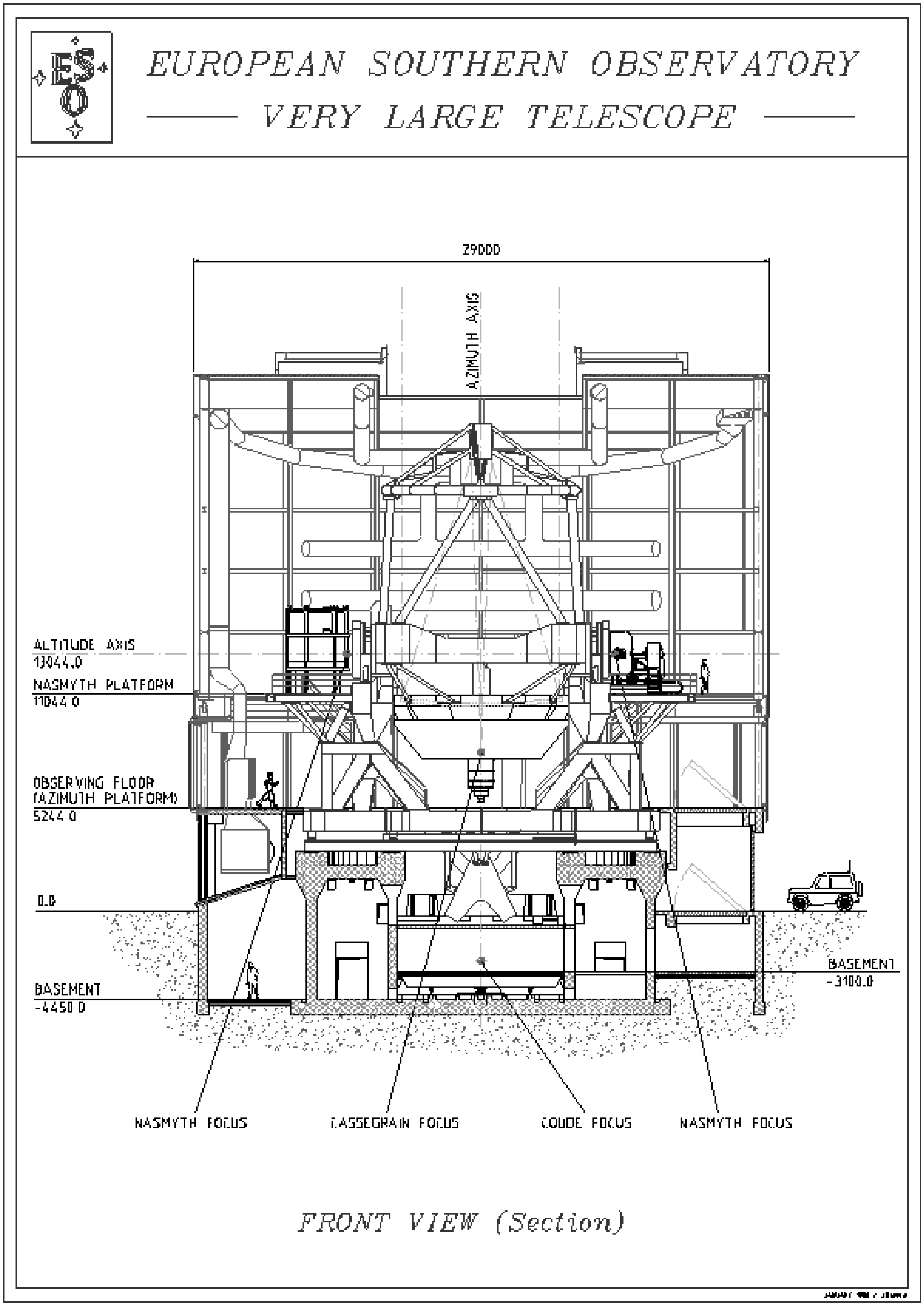

Figure 3: Front view of a Unit Telescope

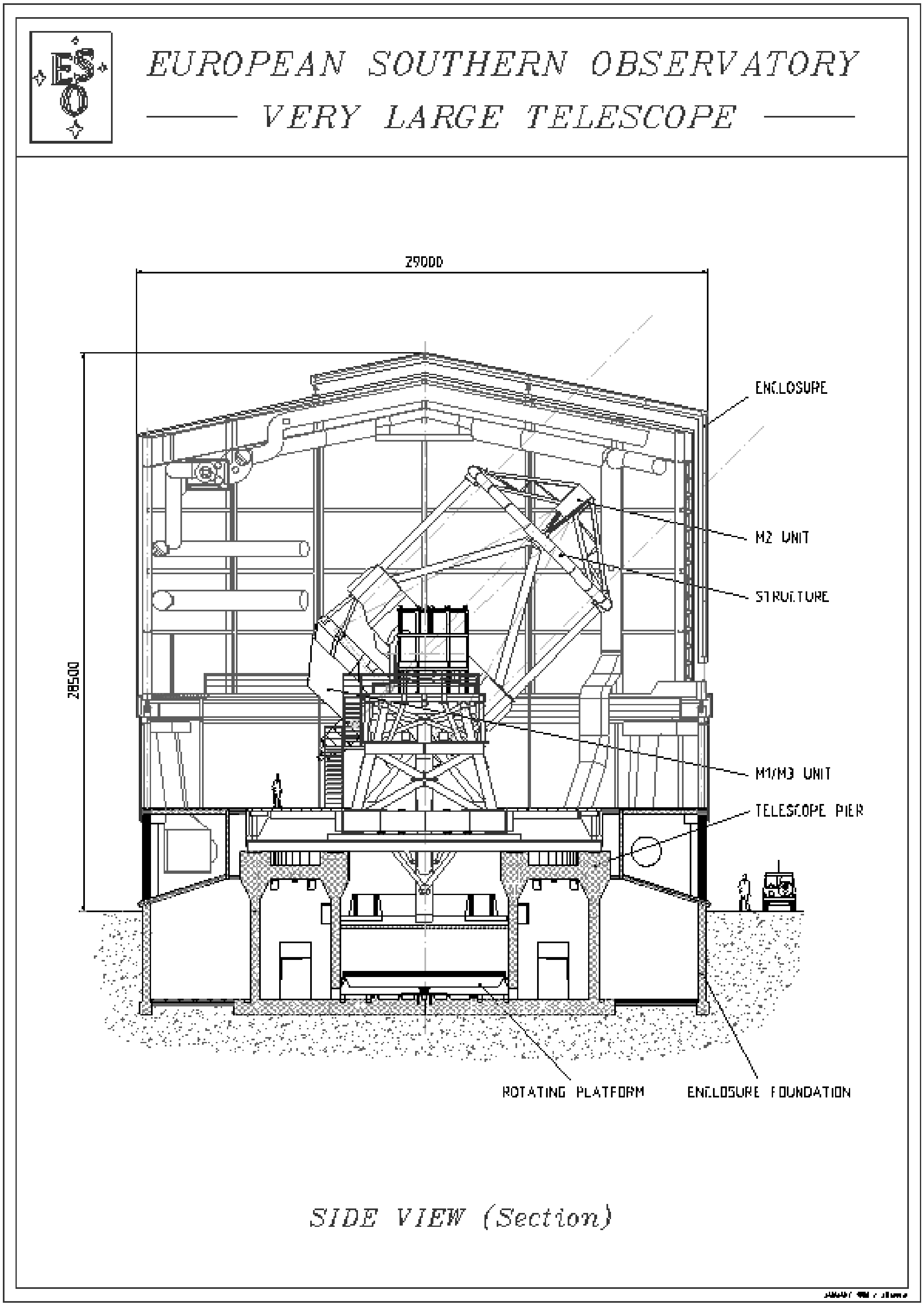

Figure 4: Side view of a Unit Telescope

Parameter		value	unit
Entrance pupil diameter		8000	mm
Focal ratio		15.000	–
Focal length		120000 ± 0.25%	mm
Object field of view	total	30	arcmin
	unvignetted	7.15	arcmin
	vignetting (10′ dia. field)	0.31	%
	vignetting (20′ dia. field)	2.14	%
Image field of view	total	1043.8	mm
	unvignetted	249.6	mm
Image scale	slightly field dependent	582	μm/arcsec
Radius of image curvature	concave towards M2	2089.6	mm

Table 2: Nasmyth focus optical parameters. For details see RD[8]

2.2.2 Optical image quality

The unit telescopes at Nasmyth are of classical Ritchey-Chrétien (RC) design and therefore have field astigmatism.
The telescope is specified to deliver a Central Intensity Ratio of 0.8 with an atmospheric seeing of 0.4″ at 500 nm. This number includes the effects of wind buffeting and tracking errors. The performance is achieved in field stabilisation mode with active optics in closed loop. There is no provision for operating the telescopes in any other mode and no performance specification is applicable when these criteria are not met. When observing with a large field of view, the telescope aberrations and, in particular, field curvature are usually the limiting factors for image quality.
The field of view may be partially obstructed by the shadow produced by the adapter sensor arm (see section 2.3.5).

2.2.3 Telescope transmission and emissivity

The primary and tertiary mirrors of the VLT UTs are recoated on average every 18 months. The secondaries which face down are cleaned and inspected but have not as yet needed to be recoated.
When freshly coated, the mirrors have reflectivities above 90% at 670nm. Apart from the early degradation in the ultraviolet, the mirrors degrade mostly due to the deposition of dust which is grey. Typically after 18 months the primary and tertiary mirrors have a reflectivity of around 85% each.
The emissivity at the Cassegrain focus has been measured at 10μm with the VISIR instrument. According to these measurements the emissivity of the VLT-UT mirror surfaces is of the order of 3% each. For an infrared instrument with rigorous masking of the pupil at an intermediate cold stop the effective emissivity of the telescope (excluding sky and instrument entrance window) can be as low as 9% at the Nasmyth focus.

2.2.4 Light baffling

The Unit Telescopes do not have conventional baffles. The pupil is determined by the secondary mirror which is designed to cover the 8 m aperture for the Nasmyth unvignetted field of view. The principal baffling must therefore be incorporated in the instrument optical design (see section 3.10).

However, because an instrument pupil will usually need to be slightly oversized due to the fact that the size and position of the pupil image is usually wavelength dependent, the secondary mirror units of the VLT UTs are equipped with extensible annular baffles located on top of the M2 units at 11729 mm above the telescope's altitude axis. These baffles can be extended to a diameter of 1550 mm according to the needs of the instrument. If the baffle is not used, the central obstruction is that produced by the secondary mirror alone (1116 mm diameter). Intermediate values of the baffle diameter are not possible. The deployment time for the sky baffle is approximately 30 seconds. Its operation should be limited to at most a few actions per night.

2.2.5 Field stabilisation and chopping

The default operation of the VLT unit telescopes requires that the secondary mirror be used in field stabilisation mode to remove the effects of wind shake. The same star is used for active optics wave front sensing and for the generation of field stabilisation corrections. The magnitude of the guide star should be in the range V = $12^m \ldots 14^m$.
Classical autoguiding is also available at the VLT (i.e. not sending the corrections to the secondary mirror but rather to the main axes of the telescope). This option does not change the magnitude limits for the guide star as it is also used for wavefront analysis and does not remove the effects of the wind shake. Details of this issue should be discussed with ESO.
The secondary mirror may also be used for chopping. The range of parameters for chopping is given in table 3. At chopping frequencies lower than 0.5 Hz it is possible to use field stabilisation mode simultaneously with chopping during the stationary periods of the chop cycle.
Note that the use of chopping is available only to VIs that are compliant with the VLT software. For more details see section 2.4.

Parameter	Value
frequency range	0.1 - 5 Hz
chop wave form	quasi square-wave
chop throw	$0''$ to $30''$ on the sky
chop orientation	any
chop offset	$-15''$ to $+15''$ on the sky
chop dwell ratio (on/off ratio)	0.7 - 1.5
maximum chop settling time	20 msec

Table 3: Chopping parameters

2.2.6 Nodding

No provision is made within the telescope control system for nodding. Normal offsets of the telescope should be used for this purpose. It is the responsibility of the instrument (or the observer) to calculate the appropriate values for the RA and Dec of the offset to achieve the specific aim of nodding.

2.2.7 Range of telescope movement

The telescope can be moved about the Azimuth axis in the range $-180°$ to $+360°$ measured eastwards from the South-point. See AD[2] for an explanation of the VLT coordinate system.

The range of movement about the altitude axis during observations is from approximately 20° to 89.5° elevation. However, tracking so close to zenith is not recommended. The zone of avoidance at zenith has a radius of 1°.

2.2.8 Pointing, off-setting and tracking accuracy

The telescope pointing accuracy is of the order of 2″ RMS in routine operations. Offsetting accuracy of 0.1″ RMS is achieved for cases where the same guide star is recovered. Offsets that require a change of guide star should be considered as new pointings.
The pointing of the telescope is always to the centre of rotation of the adapter. Offsets from this pointing axis are the responsibility of the instrument.
Tracking accuracy for the VLT over 30 minutes is better than or equal to 100 mas RMS.

2.3 The Adapter/Rotator

2.3.1 General function

Each adapter/rotator comprises two separate functional units: the adapter and the rotator. These form a single sub-assembly called the Adapter/Rotator the basic functions and performance of which are described in this section.
The rotator forms the mechanical interface between the instrument and the telescope. It defines the location of the focal plane and allows instruments to be rotated about the telescope optical axis and to follow the rotation of the optical field.
The adapter is used for the following functions:

1. field acquisition
2. guiding (auto-guiding mode using the telescope drive alone)
3. field stabilisation (auto-guiding mode using the actuation of M2 in addition to the telescope drives for a faster response time)
4. wavefront sensing for the Active Optics system

Each adapter has a pick-up mirror mounted at the end of the sensor arm which can be rotated in the field of view of the telescope. The centre of the pick-up mirror field of view can be positioned on the optical axis of the telescope. The sensor arm, in turn, is mounted on a rotating flange which can be rotated, independently of the rotator, about the optic axis of the telescope thus permitting the acquisition sensor to explore the entire field of view of the telescope. To illustrate the design principle, Figure 5 shows a cross section of the Cassegrain adapter/rotator. Note that in this view the light from the telescope comes from *below.* Details are given on ADWG-N1+2.
Light from the pick up mirror is split, by means of a dichroic beam-splitter, to feed two separate CCD sensors. One sensor is used for acquisition, guiding and field stabilisation, and the second for wavefront sensing for the active optics system. The beam-splitter directs wavelengths in the approximate range 600 − 700nm towards the acquisition/guide sensor (AGS); the remaining part of the spectrum is sent to the wavefront sensor (WFS). The sensor arm is schematically shown in Figure 6.

2.3.2 Field acquisition

In acquisition mode the adapter pick-up mirror is positioned on the telescope axis to relay the central part of the field to the AGS. In acquisition mode the AGS has the following design performance characteristics:

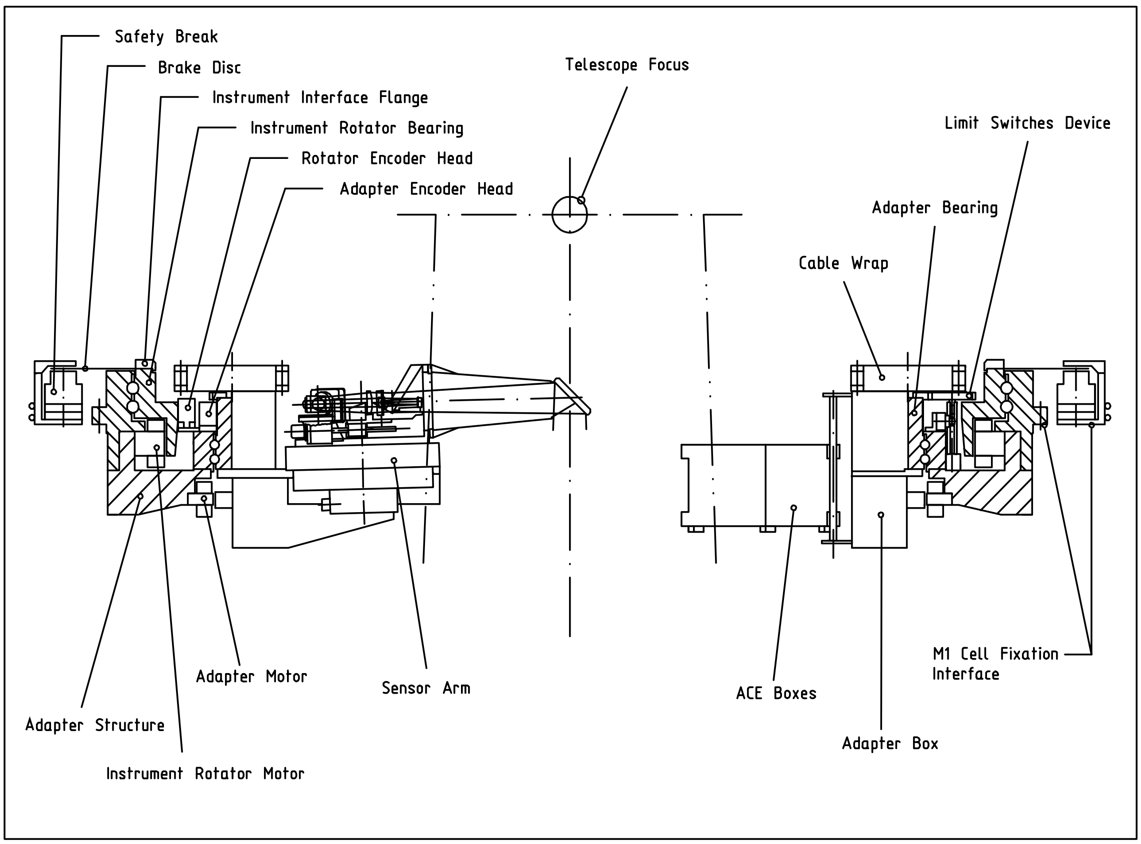

Figure 5: Cross section of the Cassegrain adapter/rotator. Note that in this view the light from the telescope comes from below. The design principles of the Nasmyth adapter/rotator are the same, the dimensions differ.

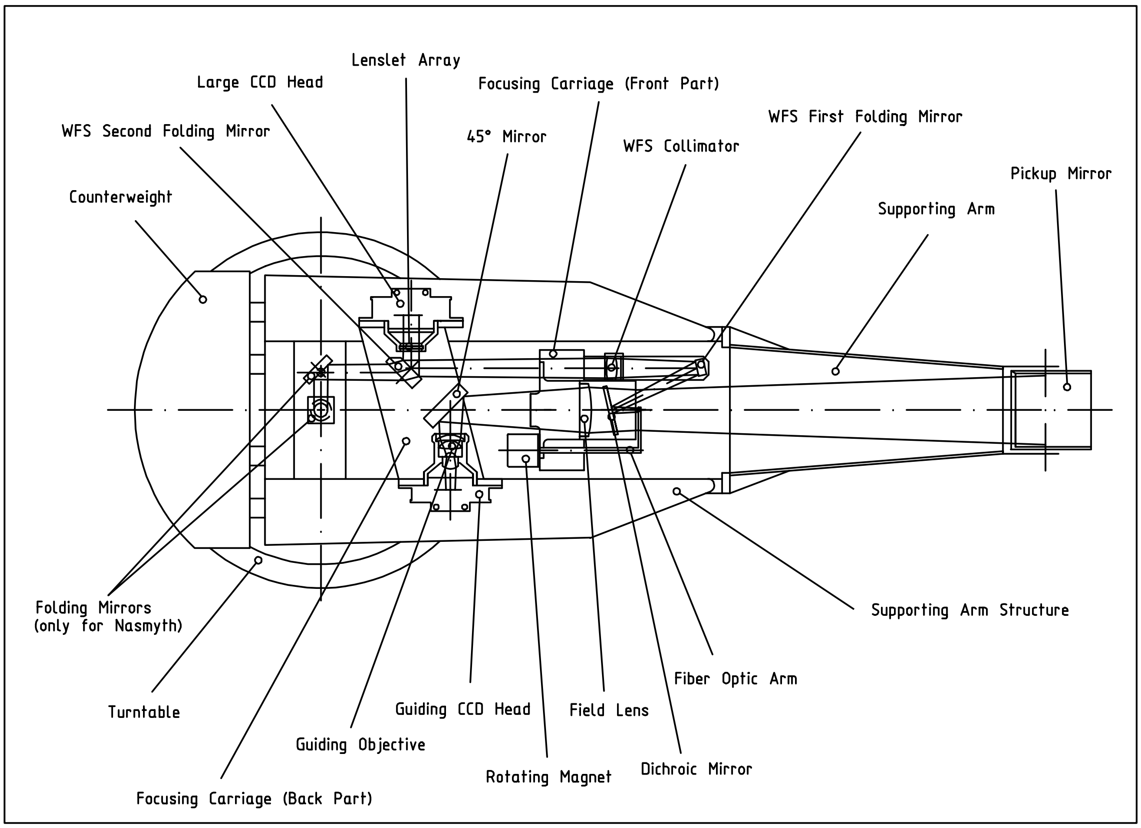

Figure 6: Schematic view of the adapter sensor arm.

1. Nominal field of view: 1 arcmin.
2. Nominal optical bandwidth: 600 – 700 nm (fixed)
3. Sensor image scale (Nasmyth): 116 μm/arcsec ($\approx$ 5 pixels/arcsec)
4. Sensitivity: magnitude $m_V \approx 21$ under average conditions and 1 s integration.
5. Frame refresh rate: 2 Hz for full frame, correspondingly faster for partial or binned readout.

2.3.3 Guiding and field stabilisation

For guiding and field stabilisation modes the adapter pick-up mirror is centered on a reference star in the peripheral field of view of the telescope. The star used for guiding is normally also used simultaneously by the WFS for Active Optics correction using a complementary waveband. Note that the optical image quality specification for the telescope given in section 2.2.2 is applicable to guiding mode.
The selection of the most suitable guide star and the positioning of the pick-up mirror is normally done automatically by the telescope control system once the object position and relevant instrument parameters have been defined[2]. This selection takes into account a defined unvignetted field (see section 2.3.5). Observers may specify in the observation block the guide star they want to use.
The telescope control system also corrects the guide star reference position during observations for the effects of differential atmospheric refraction between the wavelength used for guiding and the central wavelength used by the instrument, as well as of course for the relative changes in the observed positions of the target and the guide star with time.
In guide and field stabilisation modes the AGS has the following performance characteristics:

1. Nominal optical bandwidth: 600 –700 nm (fixed)
2. Sensitivity: Usually there will be a reference star of magnitude $m_V \leq 14$ suitable for guiding and field stabilisation. The sensor magnitude range for guiding and field stabilisation is $m_V \approx 12$ - 14
3. Measurement frequency: ≤ 30 Hz for field stabilisation, ≈ 1 Hz for guiding.
4. Guiding precision: The guiding tolerance is included in overall image quality criteria mentioned in section 2.2.2.

The instrument may provide its own wavefront sensing and guiding capabilities if compliant with the interfaces to the telescope. However, lack of full VLT compliance in the software of an instrument will make the communication of the wavefront sensing information to the telescope systems extremely difficult.

2.3.4 Wavefront sensing for Active Optics correction

The Active Optics system of the VLT compensates for static or slowly varying optical errors such as those caused by manufacturing errors, gravitational and thermal effects, the effect of lateral supports which depends on the zenith distance, etc.
During observations, the adapter WFS continually provides information on the telescope image quality to the telescope control system for active correction of the primary mirror figure

[2]Observers will nevertheless be required to select guide stars in advance to verify if sufficient guide stars are available for the observation

and the position of the secondary, using the same reference star as the AGS as mentioned in section 2.3.3.
The operation of the telescope requires that the active optics system is run in closed loop. The instrument may request that this system is not operational but this is at the expense of image quality. There is no specification on image quality for the system in open loop. Moreover, the degradation of the image quality in open loop also has effects on the plate scale and the accuracy of the guiding. It is not advisable to operate the facility in open loop.

2.3.5 Shadow from the sensor unit

The adapter sensor arm shadows a part of the telescope field of view. The shadow pattern in the Nasmyth focal plane is shown in figure 7, dimensions are given in table 4. The exact location of the shadow depends on the position of the reference star within the field. In general there are two possible positions of the sensor arm for each reference star and there is an available option to the Telescope Co-ordination Software (TCS) setup to select a specific orientation of the probe.

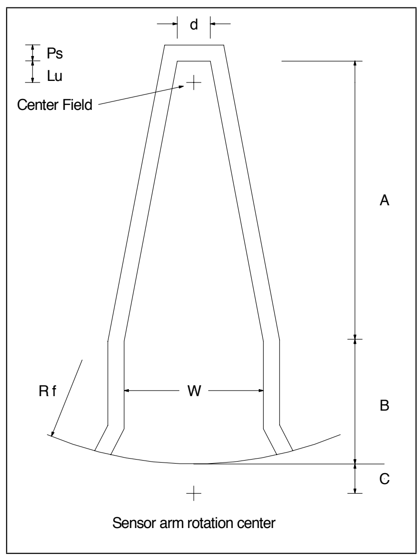

Figure 7: Guide-probe shadow in the Nasmyth focal plane. See table 4 for the dimensions.

It is possible for the instrument software to specify an area in the telescope focal plane which is to remain unvignetted by the sensor Arm. If such an area is defined, the telescope control system prefers a guide star which does not cause vignetting of this area.
In the case where all available guide stars cause vignetting of the field of view the operator may overrule the control system and demand a particular guide probe setting. The telescope database reflects the fact that the probe is vignetting the field of view. The instrument could notify the user that this is the case (VLT software compliant case only).
The guide probe can be preset in RA and DEC and offset in the same co-ordinate system. There is no option for scanning the field for guide stars.

2.3.6 Compensation of field rotation

To compensate for field rotation the position angle of the rotator (upon which the instrument can be mounted) is continuously adjusted.
RD[9] gives details on the rotation of the field and pupil images at the VLT Nasmyth focus as a function of telescope position.

A	guide probe geometry (approx.)	382 mm
B	guide probe geometry (approx.)	167 mm
C	guide probe geometry (approx.)	40 mm
R_s	radius of sensor rotation axis	560 mm
Rf	field radius	521.9 mm
W	width of umbra at the field edge	190 mm
V	width of penumbra at the field edge	–
d	width of umbra at guide probe tip	45 mm 15′
P_s	length of penumbra at guide probe tip	22 mm 0.63′
L_u	length of umbra beyond field centre	29 mm 0.92′

Table 4: Dimensions of the shadow (umbra and penumbra) of the guide probe in the Nasmyth focus. See figure 7.

max. angular tracking velocity	25′/sec
max. angular tracking acceleration	$8''/sec^2$
max. slewing speed	7.5°/sec
max. angular slewing acceleration	$1°/sec^2$
max. deceleration (emergency braking)	tel. structure: $10°/sec^2$ rotator: $12°/sec^2$

Table 5: Maximum angular velocities and accelerations to be sustained by VLT instruments mounted on the Nasmyth rotator. Emergency braking refers to maximum instrument load attached.

The precision of the correction of field rotation is such that the position error of a star at the edge of the Nasmyth field due to field rotation during a 1 hour exposure does not exceed 0.1 ″.

In order to protect instrument cable wrap systems, the rotation range of the instrument rotator is restricted by hardware limits to ±360°. In addition, adjustable software and hardware range limits within that range prevent movement beyond preset angles. These limits may be set to match the requirements of the instrument in use.

The rotator also has an electrical interlock circuit that can be connected to the instrument control electronics to block the motion of the rotator under specific circumstances (see section 3.17.1 item 1(e) for a related safety advice).

2.3.7 Maximum angular velocities and accelerations

Full details on the rotational tracking velocity and angular acceleration for VLT instruments as a function of telescope position are also given in RD[9]. The maximum rates, at a zenith distance of 0.5°, are given in table 5.

2.3.8 Focusing

Telescope focusing is achieved by moving the secondary mirror (M2). The optimum focus position is determined by the wavefront sensor in the adapter. The allowable range of movement of the focal plane is limited by the range of focus adjustment in the adapter sensor arm. The telescope control system is able to maintain the focal plane position to within an accuracy of ± 0.25mm. The instrument may request the focus to be off-set from the nominal position (within the limits specified in section 3.6) to allow for insertion or removal of pre-slit optics, for example. The adapter sensor arm contains a separate focusing mechanism that also compensates for the curvature of the focal plane as it moves across the field.

2.3.9 Nasmyth focus calibration screen

The telescope provides covers to protect the Nasmyth adapters and instruments against dust, mechanical damage, and strong illumination. These covers consist of roller-blind shutters on the inside of each altitude bearing shaft at a distance of 2.56m from the nominal focal plane. On the instrument side of these shutters, an area larger than the telescope beam is painted with a white diffusing paint to form a screen that can be illuminated by calibration sources. The space between the instrument and the calibration screen is reasonably light tight; calibrations can usually be performed during daytime while work is going on in the enclosure with the lower lights switched on. Co-ordination with the UT manager is still required.

2.4 The telescope and instrument control systems

The VLT control system has been designed with the concept that the TCS is a subsystem of the instrument. The standalone operation of an instrument is however possible.
Two options are presented below. They offer different levels of functionality. The specific proposal for compliance in the area of software should be assessed on a case by case basis.

1. Complete compliance. All software and electronics hardware systems comply with the VLT standards. This will allow the use of P2PP and the DFS to execute observations as well as full communication with all subsystems of the VLT. ESO does provide standard software packages for the instrument control both at the Local Control Unit (LCU, see section 2.4.3) and workstation level and for the Observation Software at the workstation level (baseline Observation and Instrument Control Software). Assuming the hardware (LCU) is VLT compliant then only configuration files need to be specified for the instrument control software. This is the standard for facility instruments.

2. The standalone system. There is no software connection between the VLT control system and the VI. Target coordinates etc. are entered on the telescope control console. Commands to the instrument (start/stop exposure etc.) are transmitted by optical fibres (see section 2.4.5). This option has been successfully applied to VIs.

VI consortia shall discuss these issues with ESO well in advance.

2.4.1 Visitor instrument operations

The way a VI is being operated strongly depends on the chosen level of compliance with the VLT soft- and hardware (section 2.4).
In the case of a fully compliant instrument (option 1 above) operations of a VI are essentially identical to operations of a facility instrument: Observation Blocks can be prepared using P2PP, are handed over to the Broker of Observation Blocks (BOB) inside the VLT DFS and are executed in the standard way. BOB sends setup commands to the instrument and to the telescope via LAN and, upon receiving the relevant feedback from the telescope, executes the observations. Observation data can be processed by the DFS.
In the case of a standalone system (option 2 above) all telescope operations (entry of coordinates for target acquisition etc.) are done independent from the instrument on the telescope

console. A Visitor Instrument template is available which controls the pointing of the UT; the VI team is informed when the UT starts tracking so that the exposure can be started. All operations of the VI are controlled from a computer that is located in the Control Room via an optical fibre linking it directly to the instrument control unit on the VI (see section 2.4.5). The VI computer in the control room is not connected to the VLT LAN but can receive an ntp time signal through an internet connection; this enables time synchronisation with the UT computers.
Independent of the chosen option the following rules apply:

1. **As long as a VI is installed on the Visitor Focus, a member of the VI team shall be present on the mountain. Exceptions shall be authorised beforehand in writing by ESO.** For the case that no VI team member is present on the mountain, ESO reserves the right to intervene on the VI if this is required to ensure the safety or integrity of the VLT, its installations or of the VI. Possible interventions may include the removal of the VI from the Visitor Focus.

2. spare parts are the sole responsibility of the VI team

3. the supply of consumables (except LN2) is the sole responsibility of the VI team

4. ESO will provide the VI team with LN2 in 120 litres tanks as much as needed. The VI team will be in charge of the refilling of the instrument.

2.4.2 Control system overview

The control system for the VLT and its instrumentation is based on a system of distributed micro-controllers supplemented by intelligent workstations. These processors act as nodes on Local Area Networks (LANs) which permit information and commands to be transmitted between them. The logical lay-out of the system is shown in Figure 8. More information on the configuration of the system are given in RD[10].
ESO reserves the right to refuse to install instrument computers on the Paranal LAN if it has reason to suspect that prior to transportation to ESO the system may have been infected by a virus or that security at the home institute of the VI could have been compromised. Fully VLT compliant systems automatically qualify: it is mandatory that all computers to be connected to the VLT LAN have their software re-built prior to installation at the Paranal site.
The VI team shall demonstrate that all software in use on their computers is owned by the team and that licences for the use made exist where appropriate. ESO may require that the instrument consortium remove software from its systems that is deemed to potentially interfere with the VLT system. In particular internet browsers are not permitted within the control LANs.

2.4.3 Local Control Units

Visitor instruments may deviate from the VxWorks LCU standard that ESO has selected for its own subsystems. Communication between the control room and the instrument usually takes place over the VLT LAN. An alternative for non-compliant systems is the fibre connection described in section 2.4.5. Below the ESO scheme is briefly described.
Each VLT facility instrument is controlled by one or more dedicated LCU(s) which are linked to the overall system via a LAN. The LCU(s) form an integral part of the instrument, normally physically located on the instrument itself. The LCU contains the electronic hardware necessary for the set-up, control and functioning of the instrument, data readout, self-tests, etc. Control of the instrument is done from workstations located on the network. The system architecture is intentionally very open and permits, in principle, any instrument to be

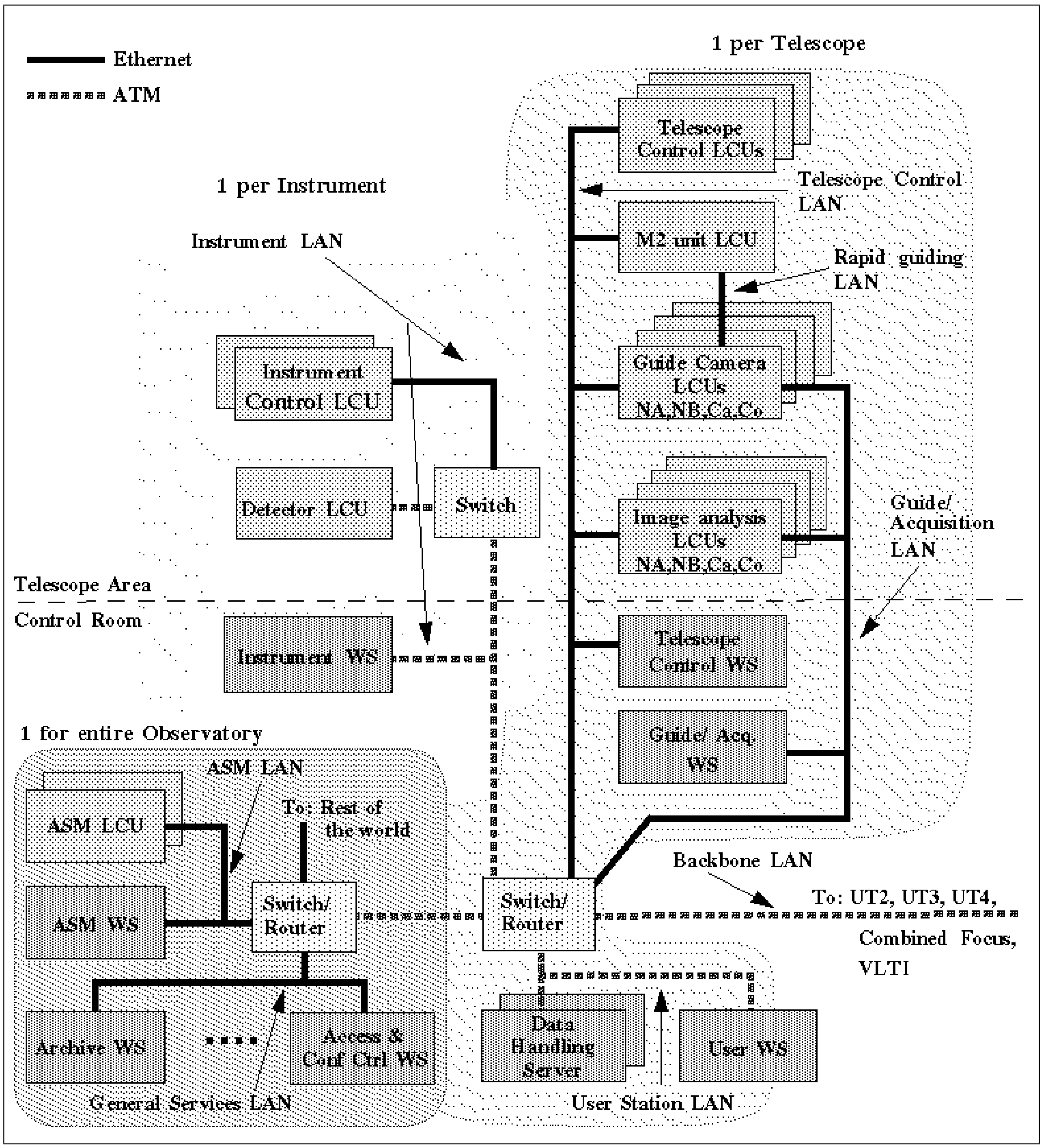

Figure 8: Logical lay-out of the VLT LANs

controlled from any workstation on the network. This implies that no dedicated instrument control hardware can be located in the workstation itself. This arrangement offers a number of advantages, including the minimisation of the number of cable inter-connections, the solution of most real-time control problems in dedicated micro-processors and straightforward testing of the instrument when off the telescope.
Instrument detector systems normally have their own separate LCU.

2.4.4 Local Area Networks

This section only applies to VIs that are VLT compliant; only these can be connected to the VLT LAN.
Visitor instruments *connected to the VLT LAN* **shall comply with the network specifications of the VLT LAN (RD[10]). All communications of the instrument with units that do not form part of the mechanical assembly of the instrument (e.g. workstations) must go via the VLT LAN system. Absolutely no communications are permitted to the VLT control LANs from the outside world (i.e. outside the mountain top).** The base camp and offices of the Paranal observatory form part of the outside world in this context. Specifically this implies that the control software for the instrument should not rely on data that are to be delivered to it from facilities outside the control LANs of the VLT. Typically the reverse process (i.e. communication from the inside to the outside) is unrestricted. **For one instrument specific IP addresses shall be allocated by Paranal, typically on a single subnet.**
The LAN system provides the means of communication and data transmission between the many LCUs on the telescopes and workstations in the control building. The LAN system comprises several parallel fibre-optic LANs, each serving specific functions such as telescope control, acquisition data, field stabilisation data, as well as instrument control and science data transmission.
Figure 8 shows an overview of the VLT LAN system. The system has been designed to allow the maximum flexibility in configuration, but also to ensure that different telescope sub-systems can operate without being affected by data congestion and priority conflicts from other sub-systems. The separate LANs are connected through a router to a backbone network which allows communication between individual telescopes and general services.
In general, each (compliant) VLT instrument is operated from one workstation called Instrument Workstation (IWS), and connected to the instrument LCUs through one LAN subnet. Although the LAN system can be configured to allow instruments to be tested from workstations located on the backbone network or elsewhere, in normal operation the router only allows operation from local workstations to ensure minimum risk of accidental interference. An overview of the complete VLT LAN system is given in RD[10].

2.4.5 User interface

In the case of a VLT compliant (according to option 1, see section 2.4) VI an IWS is used amongst other things to communicate with the telescope. There is no alternative communication protocol other than CCS (Central Co-ordination Software) messaging. For an instrument requiring communication with the TCS it is therefore necessary that such a workstation suitably equipped is available.
In the case of a standalone (according to option 2, see section 2.4) VI the computer used by the observer in the VLT control room (located in the Control Building) may be connected to the instrument using optical fibres that connect the Visitor Focus and the control room. Altogether four pairs of single mode fibres and four pairs of multimode fibres equipped with ST connectors are available.

The telescopes are operated from separate workstations, called Telescope Workstations. The on-site User, Instrument and Telescope Workstations for all VLT unit telescopes and the VLT Interferometer are located in the Control Building close to but separate from the telescope enclosures.
One console is available in the control room for the Visitor Focus. It accomodates the work place for the telescope operator, the screens displaying information on active optics, the image on the guide probe, the seeing as measured by the DIMM and meteorological data. Furthermore there is the default IWS and space for a dedicated VI control station.

2.4.6 Software

Any visitor instrument proposal shall include a section on software which elaborates which level of compatibility (option 1 or 2) the instrument team proposes to implement and how in the case of option 1 they plan to achieve this. It reminded that - except in the case of a standalone VI (see section 2.4) - the telescope and instrument form an integrated environment and therefore the software issue is not only one of interfaces but also one of safety for the telescope and personnel.
Fully VLT compliant VIs shall undergo the mandatory software code and interface checks before shipment to Paranal. Software commissioning in the telescope environment will be required before observations can start. The details shall be agreed upon with ESO in writing.

2.5 Other observatory services

2.5.1 Time Reference System

The VLT Observatory has a central Time Reference System (TRS) which distributes Universal Time information to the telescope and instrument control systems, as well as any other systems that may require this information.
For general time setting requirements, Coordinated Universal Time UTC is available to instrument control software via the Instrument-LAN (see section 2.4.4). For applications requiring a high accuracy time reference, the UTC signal is distributed directly to the individual instrument LCUs by means of a dedicated fibre-optic Time-Bus. In this case a standard electronic module (Time Interface Module TIM) within the LCU decodes the full UTC signal and provides a high accuracy local time reference for instruments. The absolute time accuracy of this reference, measured from the moment at which a processor interrupt is generated, is 10μs or better.
While UTC is available at the LCU level with high accuracy and via ntp to all systems at a lower accuracy, other timing values are also computed by the system (e.g. sidereal time) but not distributed as such.
Access to the distributed time is only available on systems that comply with VLT standards. Such access is necessary for any system that requires chopping as the synchronisation with M2 is based on absolute time.

2.5.2 Astronomical Site Monitors

The observatory operates a central Astronomical Site Monitor (ASM) to provide continuous monitoring of the prevailing astronomical conditions at Paranal as well as meteorological data. This information is available to instrument control software via the Online DataBase System. The facility also provides an archiving system to allow the accumulation of statistics for modeling and prediction. Some of the parameters currently available from the ASM are given in table 6.

Parameter	Unit	Update interval	Accuracy and/or Resolution
Seeing and Coherence Monitor			
Seeing	arcsec at 500 nm, zenith	1 min	±5%
Scintillation index	% at 500 nm, zenith	10 min	±10%
Isoplanatic angle	arcsec at 500 nm, zenith	10 min	±20%
Wavefront temporal coherence	ms at 500 nm, zenith	10 min	±20%
Satellite Sky Monitor			
Cloud cover (all sky coverage)	Phot/Variable/ Cloudy/Overcast	3 hr	90 % hit
Precipitable water vapour (all sky coverage)	mm H_2O	3 hr	1 mm RMS
Line Of Sight Sky Monitor			
RMS Atmospheric Extinction	rel. flux variation, %	10 min	±10%
Ground Meteorological Station			
Ground temperature	°C	1 min	± 0.1° C
Air temperature	°C	1 min	± 0.1° C
Relative humidity/dew point	%	1 min	±1%
Atmospheric pressure	mb	1 min	±1%
Wind direction	degrees	1 min	5.63°
Wind velocity	m/s	1 min	±2%
Airborne particles	particles/m^3	20 min	±10%
Prediction Unit (0 . . . +36h)			
Ground air temperature at 30m	°C	6 hr	1° C RMS
Ground air pressure at 2.5m	mb	6 hr	1 mb RMS
Wind velocity at 10m	m/s	6 hr	3 m/s RMS
Wind velocity at 200mb=12km	m/s	6 hr	5 m/s RMS
Cloud cover (all sky average)	Phot/Variable/ Cloudy/Overcast	3 hr	80 % hit
Precipitable water vapour (all sky average)	mm H_2O	3 hr	1.5 mm RMS

Table 6: Parameters available from the Astronomical Site Monitor

The ASM data are available online for any instrument that can communicate with the TCS.
In addition to the prevailing conditions, ESO calculates and distributes off-line predictions of the meteorological conditions at its observatories, also given in table 6.

2.6 Instrument handling and storage

2.6.1 Instrument integration

Instruments are usually re-integrated after arrival at Paranal in the integration facility in the Control Building. This facility comprises

1. space: a floor area of up to 6.7 × 13.5 m^2
2. access to a small (ca 10 m^2) lower class (100.000 with one person inside) clean-room
3. standard Service Connection Point (SCP) with electric mains, LAN connection and cooling water (see section 3.17.1)

4. filtered compressed air
5. TCS
6. size of access door: 3.1 m × 3.0 m (width × height)
7. overhead crane, see section 2.6.2

As the Control Building is located in the Telescope Area integration work should preferably be done during the day; night time access is strictly controlled and needs prior authorisation. Alternatively the instrument may be integrated directly on the Nasmyth platform at the Visitor Focus. In this case the instrument team will also have abpproximately 8×2 m^2 at their disposal on the Nasmyth access platform. This option can be permitted only for integration work that is not very time consuming in order not to interfere with the normal science operations of Melipal. Access to the telescope for any integration activity is forbidden or limited to the use of the "low lights" in the telescope enclosure until the daily calibrations are finished. Their duration depends on the amount and kind of the science observations performed during the previous night. In any case science calibrations take precedence over VI integration activities.
More information on the space available on and near the Nasmyth platform is available via http://www.eso.org/sci/facilities/instruments/interfaces.html.
VI teams shall use their own tools for any integration, test and installation activities.
Instrument teams shall discuss and agree with ESO the details of the integration activities well before the planned start of instrument integration on Paranal. This is to ensure that there are no conflicts between different teams in the use of rooms, laboratories and handling equipment.

2.6.2 Instrument transport

After assembly and test in the the Control Building integration facility the instrument is transported to the telescope (distance about 0.5 km on asphaltic road). Normally the instrument trailer (see below) is used to carry the instrument on its carriage or support (not provided by ESO). When entering the telescope building the instrument mounted on its carriage/support (and, if applicable, any associated equipment) must pass through the following:

1. the telescope enclosure main entrance door: 3.6 m × 3.9 m (width × height). Note that the clearance is reduced by the height at which the carriage with the instrument is transported (e.g. the height of the instrument trailer is approximately 0.3 m). Details of the transport into the enclosure should be discussed well in advance with ESO.
2. the enclosure trap door: 3.4 m × 3.2 m (length × width) with small obstructions (0.8 m × 0.2 m each) in two corners.

Details are given in ADWG-C3 (see appendix A). Normally the enclosure crane (see below) is used to lift the carriage/support together with the instrument (or its major parts) through the trap door to the Nasmyth platform.
For smaller items the enclosure lift can be used. It can handle loads of up to 1.2 t, the cabin inner dimensions are 2.0 m × 1.4 m × 2.1 m (length × width × height); the doors (two sided access) have a free passage of 1.4 m × 2.0 m (width × height). This lift connects all levels of the enclosure: the basement (coud/'e level), the ground floor, the azimuth platform (Cassegrain area) and the Nasmyth level.
Standard human access to the Nasmyth platform is from the azimuth floor by means of staircases. See ADWG-N3.
The following standard handling and transport devices are available at the VLT Observatory:

1. Medium fork lift, motorized
   Safe Working Load (SWL) = 3.5 t at 0.5 m and 1.5 t at 1.0 m from the fork base

2. Small fork lift, hand operated
   SWL = 2.5 t at 0.5 m, normally located at Mirror Maintenance Building (MMB)

3. UT enclosure crane
   SWL = 5 t; for the operating range see ADWG-C3. Travel and hoist speeds are:

   (a) "Long Travel" (radial) speed = 2000 mm/min (fast), 200mm/min (slow)

   (b) "Cross Travel" (tangent) speed = 2000 mm/min (fast), 200mm/min (slow)

   (c) Hoist speed = 5000 mm/min (fast), 100mm/min (slow)

4. Control building integration facility crane serving part of the area.
   SWL = 5 t, maximum hook height 3350 mm above the floor, positioning accuracy suitable for the handling of delicate equipment

5. Truck including crane.
   Crane: mounted at the rear end of the platform. Its SWL is 3 t at 3 m
   Platform: height ∼1.2 m, length = 5 m, width is standard truck size, load capacity 7 t

6. Instrument trailer
   SWL = 5 t, platform size 5.0m × 2.5m (l × w); height 0.5 m which can be reduced to ≈0.4 m

Availability and suitability of these devices for the intended use shall be clarified with and confirmed in writing by ESO at least 6 months before the arrival of the VI on Paranal. See however section 3.15.
A supply of basic handling devices (ropes, chains, shackles etc.) is available at Paranal and may be used. VI teams shall provide any special handling or lifting devices needed for a safe handling and transport of the VI.

2.6.3 Instrument installation

Installation of the instrument at the focus takes place using the carriage supplied with the instrument.
The detailed planning of all installation activities, including schedule and required resources (manpower, equipment), shall be closely coordinated with ESO.

2.6.4 Instrument storage

No provisions are made by default for protected storage of the VI other when it is installed at the telescope focus. At the request of the VI team ESO may however make storage space available for a VI packed in its transport container, but not inside a Paranal building. Environmental conditions of such storage may be harsh, including rain, snow, strong wind and solar irradiation. As an indication the measured temperature inside a white painted sea container exceeded +30∘C at times. ESO will not accept any responsibility for a VI stored at Paranal. **The exact terms of storage at Paranal shall therefore be negotiated beforehand with ESO.**

3 Requirements for VLT Visitor Instruments

The design requirements and interface specifications for VLT Visitor Instruments are given in this section.

3.1 General requirements

All VLT Visitor Instruments shall be designed to conform to the mandatory requirements (in bold type face) contained in this document and in the referenced Applicable Documents.

3.2 Instrument concept

Visitor Instruments shall be conceived as complete self-contained units which, as far as possible, can be installed on the telescope as a single pre-tested and functioning unit.
VIs must allow access to the Nasmyth adapter/rotator in case it needs servicing; for details see section 3.8.

3.3 Instrument attachment

Nasmyth instruments shall be either attached directly to the Nasmyth rotator or to the Nasmyth platform independently of the rotator.
Instruments attached to the rotator shall be compatible with the mounting flange specified on ADWG-N[1,2].
To allow an unambiguous orientation and a high reproducibility for the mounting of the instrument, the instrument interface flange of the rotator provides 3 precision pins separated by 90°; their locations and dimensions are also given in ADWG-C4. In case an instrument does not require a high reproducibility of the mounting on the rotator flange it is recommended to leave three oversized holes in the instrument attachment flange. In case an instrument does require a high reproducibility it is recommended to provide two holes equipped with an adjustment device (e.g. designed according to Figure 9) which is locked when the instrument is mounted on the flange for the first time.
Note that the optical axis and focal plane of the telescope are defined with respect to the instrument interface flange of the rotator and not with respect to the Nasmyth platform.
Instruments attached directly to the platform, as well as all instrument related equipment such as electronic cabinets, shall be anchored to the Nasmyth platform using the threaded holes specified on ADWG-N3. These holes are located on the load-bearing beams of the platform.

3.4 Use of the Nasmyth platform

Apart from instrument attachment, the Nasmyth platform may be used for the installation of independent ancillary equipment associated with the instrument, for example control electronics, thermal enclosures, etc. **Such items shall be designed in such a way as to allow them to be installed and removed in as few units as is practicable.** For example, **any electronic units not attached directly to the instrument shall be mounted in a free-standing cabinet with the minimum of interconnecting cables between the cabinet and the instrument. All such items shall be anchored to the platform using standard fixation holes indicated on ADWG-N3, or an alternative arrangement with the written agreement of ESO.** Note the requirements in section 3.14 on vibration isolation and section 3.17.2 on cabling). The Nasmyth platform

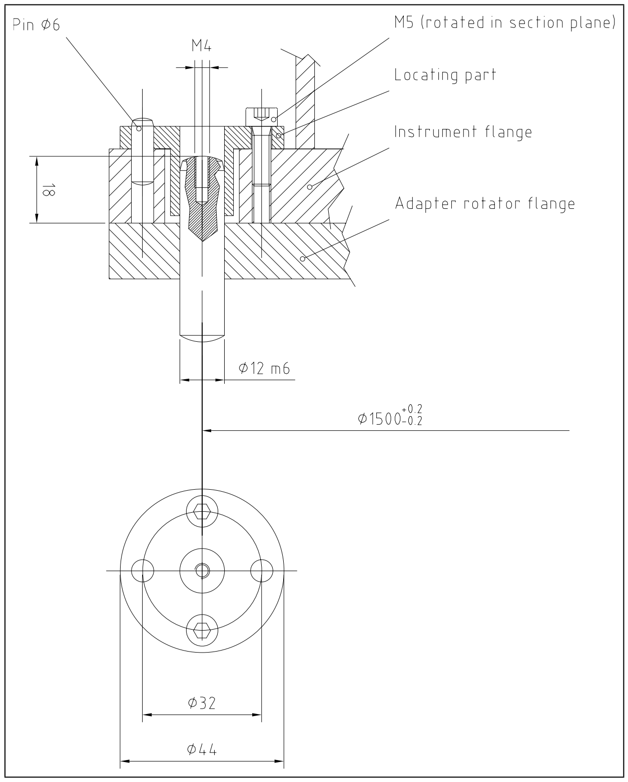

Figure 9: Proposed design for a reference pin adjustment device

may also be used for the temporary location or transportation and test equipment during the installation and commissioning of Nasmyth instruments. These items do not need to be anchored to the platform. The platform may also be used for personnel access for test and maintenance purposes. It is however not accessible during observations.

3.5 Deflection of the Nasmyth platform under load

The mechanical deflection under load of the Nasmyth platform does not exceed the following limits:

1. Operational loads:
   An operational load of 80 kN equally distributed over four points – two points on each threaded hole axis (ADGW-N3) separated by a distance of 2.5 m in the direction of the altitude axis – will not cause a vertical deflection of the support points of more than 0.1 mm. Under the 80 kN operational load mentioned above, an additional load of 1500 N anywhere on the platform will not cause an average vertical deflection of the 4 support points of more than 0.02 mm.

2. Maintenance and installation loads:
   Under a maximum load of 6000 N/m^2 distributed over the platform area plus an additional point load of 25 kN anywhere on the platform, the vertical deflection will not exceed 2 mm at any location on the platform. Under a maximum point load of 50 kN anywhere on the axis of the threaded holes, the platform vertical deflection will not exceed 0.2 mm.

3.6 Focus position

The focal plane of instruments attached directly to the rotator shall be located at a nominal on-axis Back Focal Distance (BFD) of 250 mm from the rotator instrument mounting flange. The adapter sensor arm focusing mechanism can accommodate on-axis BFD in the range 215 – 255 mm.
The height of the optical axis above the floor of the Melipal Nasmyth-A platform is 2000 mm.

3.7 Mass and torque limits

Visitor Instruments shall not exceed the following weight and torque limits. These limits shall not be exceeded during operation, instrument installation or maintenance operations.

1. **The total mass attached to the instrument rotator shall not exceed 3000 kg.**

2. **The moment applied to the instrument rotator with a moment vector perpendicular to the optical axis, at any telescope altitude, shall not exceed 30 kNm.**

3. **Instruments attached to the instrument rotator shall not apply a total moment to the instrument rotator flange due to imbalance and friction, with a moment vector parallel to the optical axis, exceeding 500 Nm in any instrument orientation. The maximum torque component due to friction alone, for example from the instrument cable wrap mechanism, shall not exceed 100 Nm.**
   The rate of change of torque during tracking shall not exceed 3 Nm/sec.
   Care must be taken in the instrument design to take account of factors such as the movement of the centre of gravity due to a change of mechanical configuration, evaporation of cryogenic liquid, the weight and stiffness of cryogen transfer hoses, cable friction, etc.

4. **The maximum mass of instrument equipment attached to the Nasmyth platform shall not exceed 8000 kg. The maximum platform loading during installation and maintenance operations shall not exceed that defined in Section 3.5**.

5. The mass limits of the rotator and the platform are independent.

3.8 Overall dimensions

Visitor instruments together with all associated ancillary equipment such as electronics cabinets, cooling equipment and thermal enclosures, shall not exceed the overall space envelope specified in ADWG-N3. Note that, although there is no explicit limit to the instrument height above the Nasmyth platform, instruments shall not extend beyond 4 metres above the Nasmyth platform floor without explicit permission from ESO
A passageway next to the staircase must be permanently kept free on the Nasmyth platform. In addition it must be possible to remove any instrument related equipment from an area in front of the adapter/rotator to allow access in case the adapter/rotator needs servicing or needs to be removed completely. Details about the location and size of these “red carpet areas” are given on ADWG-N3.

3.9 Calibration Sources

All necessary calibration sources shall be provided with the instrument.
All calibration sources that illuminate the entrance aperture of the instrument directly shall be integrated into the instrument.
Calibrations sources that illuminate the calibration screen mentioned in section 2.3.9 should also be integrated into the instrument where possible.
Externally mounted lamps may only be used if the use of integrated calibration lamps is proved to be impractical, and with the written agreement of ESO. The procurement of external calibration lamps or sources, their power supplies and interface circuitry shall be the responsibility of the VI team, as well as their control. Note that the calibration lamps should comply with the heat dissipation requirements (section 3.16).

3.10 Sky baffles

The VLT UTs do not provide conventional sky baffles; sky baffling is therefore the responsibility of the VI. The secondary mirror baffle described in section 2.2.4 may be used by the VI.

3.11 Atmospheric dispersion compensation

No atmospheric dispersion compensation is provided at the UT Nasmyth foci.

3.12 Chopping control

The normal way of synchronising the chopping of the M2-unit and instrument data taking is through the use of the TRS (see section 2.5.1). In addition to the normal chop parameters provided by the instrument software, (chop throw, chop orientation, chop position, see section 2.2.5), the sequencer program in the host workstation defines the absolute UT starting time for the chop sequence and the dwell times in each position. This information is used by the M2-unit control system to move from one chop position to the other at the absolute UT time defined by the set-up parameters. The instrument control system uses the information to synchronise control and data taking. The set-up procedure for the M2-unit allows the chop transition time to be accurately ascertained and accounted for.
Standalone VIs (see section 2.4) will have no synchronisation signal from M2 as this is done on absolute time only. The VI that wishes to use chopping will require an LCU with a TIM (TRS) board.

3.13 Pupil motion compensation and alignment

Gravitational and thermal flexure as well as alignment errors may cause the nominal optical axis of the telescope to be misaligned with the mechanical axis of the rotator. This causes a motion of the telescope pupil with respect to the instrument pupil. The maximum tilt of the axes does not exceed 2 arcminutes. If this is considered as a serious problem, a pupil motion control will have to be included in the instrument.

3.14 Vibration

All equipment attached to the telescope or installed on the Nasmyth platform which produces vibration (motors, pumps etc.) shall be adequately isolated mechanically from the telescope structure to prevent the transmission of vibrational

disturbance to the telescope structure. Installation and operation of such equipment requires the written approval of ESO who will determine if any special verification procedures are required.

3.15 Instrument handling and storage

The telescope Nasmyth A Platform is normally accessed from the Nasmyth Access Platform which is on the fixed part of the enclosure at the same level as the Nasmyth platform (as shown in Figure 3). Note that this requires the telescope to be in the so-called "parking position". The Nasmyth platform can be reached at any time, however, by means of a staircase on the telescope structure which goes down to the Azimuth platform level (see Figure 4 and ADWG-N3).

The Nasmyth Access Platform is served by a lift as well as an additional staircase. The lift is only intended for the transport of equipment. Its properties are given in section 2.6.2.

The Nasmyth Access Platform and the telescope Nasmyth platforms are protected by guard rails and sliding gates, see ADWG-N[4+5+6]. To transport bulky equipment onto the Nasmyth platform, the gates and railings can be removed completely in sections. In this case **Paranal staff shall activate the corresponding lock-out.**

Larger pieces of equipment can be brought into the enclosure via the main access doors at ground level. They are lifted onto the Nasmyth platform through the enclosure trap door using the enclosure crane. Details of the passages and the crane are given in section 2.6.2.

All Nasmyth instruments mounted on the adapter/rotator shall be provided with a mechanism which allows to move the instrument on the Nasmyth platform, in particular to give access to the adapter/rotator (see section 3.8). Provisions shall be included for mounting the instrument on the rotator or platform. This mechanism shall use the rails available in the floor of the Nasmyth platforms (see ADWG-N3). It is mandatory that at least the "red carpet areas" (see 3.8 and ADWG-N3) can be cleared within 1 hour. A separate storage stand or base shall also be provided for the instrument when not attached to the telescope if the rail-based mechanism cannot fulfil this function.

Major instrument carriages shall be certified for compliance with applicable safety regulations by an approved agency (TÜV or equivalent).

If necessary, the main beams installed in the Nasmyth platform may be employed for the attachment of rails for instrument installation. The location of these beams is specified in ADWG-N3.

All instrument equipment that has to be lifted onto the Nasmyth platform using the enclosure crane must be provided with lifting eyes suitable for the purpose.

A list of standard handling and transportation devices that are available at the observatory is given in section 2.6.2. Any additional handling, transportation or adaptation devices necessary for the instrument will have to be provided with the VI.

VIs shall specify explicitly their storage requirements. A priori no provision exists on Paranal for storage of delicate optomechanical systems other than when mounted on the telescopes. **Storage of the instrument must comply with the earthquake and other safety aspects.** ESO while exercising all due care does not take any responsibility for visitor instrumentation stored on the Paranal site.

3.16 Thermal control

The maximum temperature difference between any exposed surface of the instrument (or of any associated equipment) and ambient shall be $\leq$ +1.5/-5.0°C

in wind-still conditions, with a maximum upwardly convected energy for the instrument and all associated equipment of 150 W. The weighting factor to be used for negative energies is 0.3. These thermal requirements are considered to be average values over any 30-minute period.
In order to meet the thermal specification, instruments and their associated control electronics may need active thermal control and have their exposed surfaces insulated. Instruments may make use of the telescope cooling system (see section 3.17.1) in order to meet the thermal environment requirements.

3.17 Electrical and fluid connections

3.17.1 Service Connection Point

Most telescope sub-systems and equipment are connected to the telescope electrical and fluid supplies, and to the communication networks at centralized distribution points called Service Connection Points (SCP). The SCPs are composed of three parts which provide electrical, communications and fluid connections, respectively. A full description of the SCP is given in RD[11]. The following sections provide an overview of the SCP connections and list the principal interface requirements.
Two SCPs for the connection of Visitor Instruments are provided on the Nasmyth platform, one located on each side of the platform. **All cables and hoses connecting Visitor Instruments to the telescope service supplies shall be connected via these SCPs.** The locations of the Nasmyth instrument SCPs are shown on ADWG-N[3+4+5].
The following list gives a summary of the services provided at the SCPs.

1. SCP Part A: Electrical connections

   (a) 400 VAC, 50 Hz, three-phase, neutral and earthing

   (b) 230 VAC, 50 Hz, single-phase, neutral and earthing

   (c) 230 VAC Uninterruptible Power Supply (UPS), 50 Hz, single-phase, neutral and earthing

   (d) Auxiliary earth connection

   The power quality is specified in AD[3].
   Safety is provided by FI circuit breakers with a typical rating of 30 mA.
   In addition to the socket outlets, power connection to normal or UPS power may also be via direct connection to terminal blocks inside the SCP. Details of the socket outlets and the internal electrical connections are given in RD[11].
   Equipment connected to the SCP electrical socket outlets shall conform to the following requirements:

   - **The peak electrical current drawn from one SCP must not exceed 16A per phase for the normal electrical supply, and 16A total for the UPS supply.**
   - **The total average electrical power taken from the UPS outlets by Nasmyth instruments shall not exceed 2 kW per SCP. The total average non-UPS electrical power shall not exceed 6 kW per SCP without the written agreement of ESO.**
   - **Electrical equipment connected to the SCP must respect the EMC requirements for susceptibility and emissions given in AD[4].**

- **The requirements for the design and implementation of electronic equipment contained in RD[12] shall be applicable to all equipment connected to the SCP.**
- **All fuses, circuit breakers and residual current detectors required for the protection of the instrument, supply cables or operator shall be incorporated in the instrument concerned.**

During the commissioning period of instruments, it may be more convenient to connect the instrument to the power socket outlets on the front panel of the SCP to allow easy disconnection. Once commissioning is completed, instruments are normally connected to the internal power distribution terminal blocks of the SCP.

(e) Local interlock connections
Each instrument SCP provides access to the instrument rotator interlock system. This comprises a normally closed loop circuit which, when opened, prevents motion of the rotator by cutting power to the drive motor. Note that it does not cut electrical power to the instrument or adapter/rotator LCU. This facility is intended for use during operation or maintenance activities to prevent damage or injury to personnel, the instrument or the telescope.
The Local Interlock connection can be used, for example, to prevent damage to the instrument cable wrap in the event of an emergency situation. Such a situation could conceivably occur if the rotator unit has been incorrectly initialized, or due to a hardware failure in the rotator control electronics. **It is strongly recommended that instrument designers use this facility as a secondary security system in cases where uncontrolled rotation of the rotator could lead to serious instrument damage.**
Access to this circuit is only possible through direct connection to terminal blocks inside the SCP. The following must be observed by instruments using the Local Interlock facility:

   i. **External switches and relays used to break the Local Interlock circuits shall be normally closed rated at $\geq$ 2 A with 230VAC and 24VDC. The exact type of switch used shall be approved by ESO.**
   ii. **There must be no galvanic connection between the Local Interlock circuit and any other circuit or ground.**

(f) Emergency Stop facility In addition to the Local Interlock, each instrument SCP is equipped with a Emergency Stop facility. This comprises a red mushroom-type button on top of the SCP and a key switch. Either pressing the button or removing the key will immobilize all major subsystem functions in the telescope enclosure.
A centrally located set of lockout switches is available to immobilize particular parts of the telescope/enclosure. The usage of these switches is governed by the lockout procedure and restricted to Paranal staff. Note that, like the Local Interlock, emergency stops do not cut power to the LCUs (see section 2.4.3).
A connector is available on the lower surface of all instrument SCPs to allow the attachment of an extension cable for a remotely located Emergency Stop button. A bridging connector is provided on each SCP which must be plugged in when no extension cable is in use. **All such extensions shall be approved by ESO prior to use.**
A single emergency stop button for each telescope is available in the control room at each console. No provision is made for cabling from the instrument to the control room, dedicated for this purpose.

2. SCP Part B: LAN connections

   (a) Local Area Network (see section 2.4.4)
   SCP Part B allows the physical possibility of connection to the VLT LAN system. The allocation of the LAN connections for scientific instruments is specified by ESO for each individual instrument. The SCP fibre-optic cables are supplied from Network Access Points (see RD[10]) where the function of each SCP LAN connection is determined. All SCP LAN connectors are of the following type:
      - SCP Output connector: ST type
      - Fibre-type: Multi-mode, graded index (62.5 μm core, 125 μm cladding)

   (b) Time Reference System (see section 2.5.1)
   The TRS connectors and optical fibres are identical to those for the LAN given in the previous item.

3. SCP Part C: Fluid connections

   (a) Compressed air supply
   Compressed air is provided at the SCPs with the following characteristics:
      - Supply pressure: 7-8 bar
      - Filtering: ≥ 5 μm
      - Oil content: < 0.01 ppm
      - Relative humidity: $\leq 10\%$ at 20°C at local atmospheric pressure
      - SCP Outlet connector: Self-sealing female connector according to ISO 7241-1 Series B, nominal diameter 12.5 mm.

   (b) Coolant supply
   The central observatory chiller system provides a supply to coolant at the SCPs which may be used for instrument cooling. The coolant has the following characteristics:
      - Coolant: water with 33% (vol.) ethylene glycol
      - Nominal maximum supply pressure: 6 bar
      - Supply differential pressure: min 0.8 bar, max 2 bar
      - Supply temperature: 8°C below ambient.[3]
      - Nasmyth instruments: Maximum flow rate (per SCP): 15 l/min. **The specific needs of the instrument shall be assessed in cooperation with ESO.**
      - Equipment connectors: self-sealing connectors according to ISO 7241-1 series B, size 12.5 mm (output male, return female)

   Equipment connected to the SCP coolant supply shall conform to the following requirements:

      i. **Connected equipment shall use self-sealing connectors on both feed and return lines**
      ii. **All connecting cooling hoses shall be insulated to ensure that the thermal requirements specified in section 3.16 are met.**
      iii. **Hoses shall be positively clamped to the connector.**
      iv. **All hoses shall be of a type suitable for a working design pressure of at least 12 bar. Equipment shall be filled and leak tested at a pressure of 10 bar before connection.**

[3]The temperature of the coolant will be nominally 8°C below ambient, but it will not sink below -8°C or the external dew point.

v. **Equipment having a total coolant capacity greater than 3 liters, as well as all equipment which is not self-purging, must be pre-filled with the appropriate cooling liquid before connection to the SCP coolant supply. Other equipment may be filled by direct connection to the cooling system.**

vi. **The coolant return temperature shall not be higher than 8°C above the supply temperature. The maximum thermal load for each SCP shall not be more than 6kW (30 minute average).**

vii. **The instrument cooling system shall be dimensioned such that the coolant flow speed through any part of the system is not greater than 1.2 m/sec.**

viii. **All equipment attached to the coolant supply shall provide monitoring of the coolant return temperature.**

ix. **All instruments which make use of the telescope cooling system shall incorporate any protection mechanisms necessary to prevent damage to the instrument or to its control electronics in the event of a failure in the flow of coolant.**

x. **The use of additional shut-off valves is strongly recommended.**

3.17.2 Cables and hoses, cable wraps

No unguided free hanging cables or hoses longer than 1 m are allowed. Wherever possible, all interconnecting cables and hoses longer than 1 m should be laid in fixed cable ducts with removable covers.

A cable wrap/twist system should be provided for transferring cables and hoses to the instrument on the Rotator. The torque induced by this facility shall be included in the global torque budget of the instrument (see section 3.7).

There shall be no loose cables crossing areas of the Nasmyth platform that will be frequented by observatory maintenance staff (except cables of a temporary nature required for commissioning only). Note that access holes on the Nasmyth platforms are provided to allow cables and hoses from an instrument installed on the platform to pass underneath the platform to equipment installed along the sides of the platforms or to the SCPs. See ADWG-N3 for details.

3.17.3 Cable and connector markings

All interconnecting signal cables and non-standard power cables that are not permanently attached to equipment shall be marked to identify the instrument or equipment to which they belong.

In addition, all connectors (or cable ends) shall be marked to uniquely identify them. All mating sockets shall also be correspondingly marked. Cable connector and socket identifications shall be the same as those used in the instrument documentation.

All standard power cables that are not attached to equipment need not be marked. However, **power cables that are permanently attached to equipment as well as panel mounted power inlet sockets shall identify whether the cable is intended for normal mains or UPS power.**

Additional requirements on cables and connectors are given in RD[12].

3.18 Alarm handling

An Central Alarm System (CAS) is available on Paranal and VIs may be connected to it. The definition of alarms and their handling is described in [13]. The purpose of an alarm is first to warn of any event which could endanger people, damage the telescope and its installations or jeopardize its functioning. **VIs shall implement the alarms for these types of risks.** In addition, VIs may generate alarms in cases where a fast intervention is needed, e.g. in case of risk for expensive equipement or critical parts of the VI. As described in [13], these instrument alarms are received on the beeper pager of the Paranal Instrumentation Group responsible person. VI staff will then be informed so that they can react accordingly. ESO recommends to use the alarm annunciator described in [13]. The VI may define up to 8 different alarms and connect them to the alarm annunciator input although by default, any instrument should connect only one alarm to the CAS.
Connection to CAS does not guarantee a response time nor should it be regarded as a safety measure. It is only intended as an additional means of alert. CAS does not replace safety devices. **The safety plan for the instrument shall not take into account CAS as means to mitigate problems.**

3.19 Requirements for instrument control electronics

Visitor instrumentation may deviate from the ESO standards with respect to the selection of components to be used. Clearly the level of support that can be provided to such a system by the engineers at the observatory is significantly less than in a compliant system.
Details on standard electro-mechanical components are listed in RD[12]. In any case ESO cannot provide spare parts; they shall be supplied by the VI team.

3.20 General software requirements

It is strongly recommended that a VI team discusses with ESO their plans regarding the level of VLT hard- and software compatibility (section 2.4) before submitting their proposal. Note that for a system using VLT standard hardware components the software to operate the instrument is available from ESO and requires only configuration rather than significant coding.
The requirements on software supplied with fully VLT compliant instruments are contained in the following documents and the references contained therein. These documents also define the software standards to be adopted for VLT instrumentation:

- 'VLT Instrumentation Software Specification' (RD[14])
- 'Template for Software Management Plan' (RD[15])

A non-compliant VI may deviate from these requirements. In the case of a fully VLT compliant VI more VLT software documents are applicable. **Details shall be discussed with ESO.**

3.21 Detailed software specifications

3.21.1 Workstation operating system

For fully VLT software compliant systems **UNIX System V shall be used as the standard operating system for the Workstation system software, and X-Windows Version 11 shall be the standard presentation software for the User Interface.**

Standard configurations for Paranal (e.g. workstation hardware platforms and operating systems) can be obtained contacting ESO.[4]

3.21.2 Communications software

The TCP/IP protocol shall be used for LAN communications.

3.22 System and common software to be made available by ESO

Standard software packages are made available on request to VI teams for use by the instrument software. They are listed in RD[14] and the documents referenced therein.

3.23 Maintenance Software

Maintenance software is required for a visitor instrument if it has safety implications, (e.g. checking the cool down of a cryogenic instrument.)

4 Requirements on Instrument Implementation

In addition to the requirements mentioned elsewhere in this document, there are several other considerations that must be respected for all VLT instrumentation control systems. These are necessary because of the need for multiple-telescope use as well as for maintenance purposes. A number of these implementation requirements are explicitly referring to issues that make it possible to interface an instrument on the VLT telescopes. As such some applicability for VIs exists as marked below.

1. **There must be no need for physical proximity or local intervention to the instruments during observations. All status and controls, as well as reset/restart procedures shall be under software control and accessible via the Instrument-LAN or the dedicated fibre link.** This is applicable to all VIs irrespective of the software solution proposed.

2. **There shall be no special hardware links between the instrument LCU and the IWS or the user**, such as command switches or potentiometers, lamp displays, oscilloscope displays, etc. This is also applicable to VIs.

3. **Instruments shall be conceived so that they can be switched to Stand-by Mode when they are not in operation. In this mode, all parts of the instrument and its associated ancillary equipment that are not required for reasons of maintaining LAN contact, or for maintaining the temperature of critical components (for example detectors) should, where possible, be powered off. Switching between Power-on and Stand-by modes shall be done through remote commands.**

4. Cryostats for instrument and/or detector cooling should not require re-filling more frequently than once every 24-hours after the normal operating temperature has been attained. A filled LN2 tank (manufacturer: Cryodiffusion; type: XRP 120; capacity 127 litres, flange diameter NW50) will be provided by ESO upon request. **The transfer line from the tank to the instrument shall be provided by the VI team. A manometer shall be fitted on the transfer head to enable a reading of the pressure in the tank. The refilling of the instrument or detector cryostat shall be done by the VI team.**

[4] The use of non-standard hardware may complicate the installation procedure.

5. **VIs shall be easily removable from the telescope, preferably as single units including the LCU**.

5 Safety Requirements

The general safety requirements defined in AD[5] are applicable to VIs as well as to all their associated handling, test maintenance and alignment devices. A safety analysis shall be carried out for each VI according to that document.

The VI team shall be able to demonstrate its compliance with the requirements described in this document and any additional requirements placed at the time the contract is agreed upon prior to shipment of the instrument to Paranal (see section 8). Specifically, a full hazard analysis shall be presented and accepted by ESO prior to shipment to Paranal.

In particular an earthquake analysis shall be prepared according to AD[6] which demonstrates that the planned VI will not present a risk to staff or installations of the VLT under the specified conditions.

6 Environmental Requirements

The requirements below have safety implications and are therefore applicable to a visitor instrument.

All VLT Instruments, as well as any associated ancillary equipment and components, shall meet the environmental conditions specified in AD[1]. This document lists temperature range, humidity level, dust and shock specifications, etc., to be met during transport, storage and operation and includes the survivability of earthquakes.

For information purposes, instruments should be designed for *operation* under the following conditions:

1. Max. ambient air temperature range (day and night): -5° C to +25°C
2. Max. ambient air temperature range (night only = operational range): 0°C to +15° C
3. Ambient air temperature change during the observing night: $\leq \pm 3$°C on 80% of nights, $\leq \pm 4$°C on 95% of nights
4. Maximum ambient air temperature gradient during the observing night: $\leq^{+0.5}_{-0.9}$ °C/hour on 80% of nights, $\leq^{+1.0}_{-1.4}$ °C/hour on 95% of nights
5. Change in minimum ambient temperature between consecutive nights: $\leq \pm 2.2$°C on 80% of nights, $\leq \pm 3.5$°C on 95% of nights
6. Relative humidity: 0 – 95 %

All VLT Instruments, including VIs, as well as any associated ancillary equipment and components, shall meet the electro-magnetic compatibility requirements which are specified in AD[4]. This document specifies limits for electro-magnetic emission and immunity applicable to instrument electrical and electronic systems.

For the applicable thermal control requirements, see section 3.16.

7 Documentation requirements

For VIs the documentation (written in English) shall include instructions for powering the system down and removing it from the telescope in the absence of members of the instrument team (see section 2.4.1. The procedures to be followed during the powering up of the instrument should also be provided[5]. **Documentation on emergency shutdown procedures shall be included.**

8 Verification

Visitor instruments shall demonstrate their compliance with the basic requirements of the observatory. ESO will follow its standard verification rules for such checks, i.e. all requirements and specifications (as given in this document and the Applicable Documents) will be verified based on documents submitted by the VI team.
Additional verification procedures for VIs may be specified in the agreement for the VI in question. Verification of the requirements and specifications contained in this document are detailed in the following sections.

8.1 Verification by design

Except where otherwise mentioned below in sections 8.2 and 8.3, **all requirements defined in this document shall be subject to design review by ESO using computer modeling where necessary.** Commercial components shall be checked against manufacturers data sheets and test reports.

8.2 Verification by inspection

The requirements listed in sections 3.17.2 and 3.17.3 on cable installations and marking shall be verified by inspection after installation.

8.3 Verification by test

The requirements listed in sections 3.6, 3.7 and 3.8 shall be verified by test after instrument integration. The requirements listed in sections 3.14 and 4 shall where applicable be verified by test after installation.
In the case of a VLT software compliant VI the proper implementation of the software interfaces and of the templates that address directly the VLT environment. For this purpose a dedicated software commissioning shall be foreseen before the start of observations. Details (schedule, duration) shall be discussed with ESO well in advance.

9 Visitor instrument proposal template

9.1 Scientific justification

The Visitor Instument proposal shall describe the science case for the instrument on the VLT. It shall describe the current status of the instrument, e.g. if it is a project or an already existing instrument. In the latter case a short history of operation should be included.

[5]In the rare event of a power failure on Paranal or the necessity to power down the entire telescope it might be necessary to power cycle the instrument in the absence of the instrument team

9.2 Safety

A preliminary hazard analysis of the instrument for all phases of its re-integration, installation, operation, uninstallation and removal following delivery to Paranal shall be provided at the time of proposal. Potential hazards (e.g. high voltages, liquid helium etc.) shall be explicitly addressed in the proposal.

9.3 Operational scenario

A visitor instrument proposal shall describe the operational scenario envisaged by the instrument builders.
In particular the number of nights requested shall be stated. The request should be split into the amount of time expected to be used to make the instrument operational at the telescope (commissioning) and the number of nights to be used for scientific programmes. How the later would be distributed over the ESO observing periods should also be addressed.
The proposal shall state the number of personnel required to operate the instrument as well as the use of consumables at Paranal (e.g. LN2, storage media etc.).
The kind of observations envisaged should be discussed (e.g. frequency of presetting, offsetting, chopping etc.).
The operational scenario shall include the amount of daytime access to the instrument required for calibrations, maintenance etc.

9.4 VLT compliance choices

A VI proposal shall explain the planned software and hardware compliance and/or deviations from the VLT standards.

9.5 Integration requirements

The specific support required to re-integrate the instrument on site as well as the duration of the re-integration period should be addressed in the proposal.

9.6 Installation requirements

The specific support and time required to install the instrument on the telescope should be addressed. Specifically the compliance with the cooling and connectivity requirements should be addressed.

10 Applicable and Reference Documents

The following list gives the full references of documents cited in the text. Many of the software and data flow documents are available online from ESO. The others will be made available by the ESO Instrument responsible.

10.1 Applicable documents

The following Applicable Documents (AD) contain mandatory requirements and specifications for VLT science instruments including Visitor Instruments.
The precise issue number of these documents applicable to any particular instrument contract will, where necessary, be specified in the contract or agreement.
Applicable drawings (ADWG) are listed separately in Appendix A.

References

[1] **'VLT Environmental Specification', document no. VLT-SPE-ESO-10000-0004**

[2] **'Basic Telescope Definitions', document no. VLT-SPE-ESO-10000-0016**

[3] **'Electro-magnetic Compatibility and Power Quality Specification', Part I, document no. VLT-SPE-ESO-10000-0002**

[4] **'Electro-magnetic Compatibility and Power Quality Specification', Part II, document no. VLT-SPE-ESO-10000-0003**

[5] **'Safety Conformity Assessment Procedure', document no. SAF-INS-ESO-00000-3444**

[6] **'Instructions for earthquake analysis', document no. VLT-SPE-ESO-10000-1853**

10.2 Reference documents

The following Reference Documents (RD) contain general information relevant to the VLT and its instrumentation and operations.

[7] 'The VLT White Book', available from the ESO web site at `http://www.eso.org/outreach/ut1fl/whitebook/`

[8] 'VLT Optics: Design of telescope optics', document no. VLT-TRE-ESO-10000-0526 issue 1.B

[9] 'Field and Pupil Rotation for the VLT Units', VLT-TRE-ESO-11000-3526

[10] 'Final Lay-out of VLT Control LANs', document no. VLT-SPE-ESO-17120-1355

[11] 'Service Connection Point Technical Specification', document no. VLT-SPE-ESO-10000-0013

[12] 'VLT Electronic Design Specification', document no. VLT-SPE-ESO-10000-0015

[13] 'Implementation of an Alarm System for the Paranal Observatory', document no. VLT-SPE-ESO-12115-2795

[14] 'VLT Instrumentation Software Specification', document no. VLT-SPE-ESO-17212-0001

[15] 'Template for Software Management Plan', document no. VLT-PLA-ESO-17240-3786

[16] 'Data Interface Control Document', document no. GEN-SPE-ESO-19400-0794

All VLT documents are available from ESO via the responsible contact person for the instrument.

APPENDICES

Full scale copies of the drawings listed in this appendix are available from ESO via the responsible contact person for the instrument.

A Interfaces Between Nasmyth Instrument and Telescope Environment

The interfaces between VLT Nasmyth instruments including Visitor Instruments and the telescope environment is given in the following applicable drawings (ADWG):

ADWG	Title of Drawing	drawing number
N1	**VLT-Nasmyth Interface Nasmyth Instrument Flange A Rotator, cross section**	**VLT-DWG-ESO-11420-2615**
N3	**VLT-Nasmyth Interface Nasmyth Platform A Top view and floor requirements**	**VLT-DWG-ESO-11420-2617**
N4	**VLT-Nasmyth Interface Nasmyth Instrument Flange A: Front view with telescope installations**	**VLT-DWG-ESO-11420-2618**
N6	**VLT-Nasmyth Interface Nasmyth Platforms Access and handling constraints**	**VLT-DWG-ESO-11420-2620**
C3	**VLT-Cassegrain Interface Observing Floor Plan Installations and floor loads**	**VLT-DWG-ESO-11430-2054**

Table 7: Applicable drawings for the interface between Nasmyth focus visitor instruments and the telescope environment

Drawing (ADWG-C3) is reproduced here because it shows (among other details) the dimensions of the access openings to the enclosure.
These drawings can be downloaded as high resolution .pdf files from
`http://www.eso.org/sci/facilities/instruments/drawings/`.
All Visitor Instruments and their handling and maintenance procedures shall be designed to be compatible with these drawings. The current valid versions of these drawings shall be used for all design and construction work. The CAD files will be made available through the responsible ESO contact person.

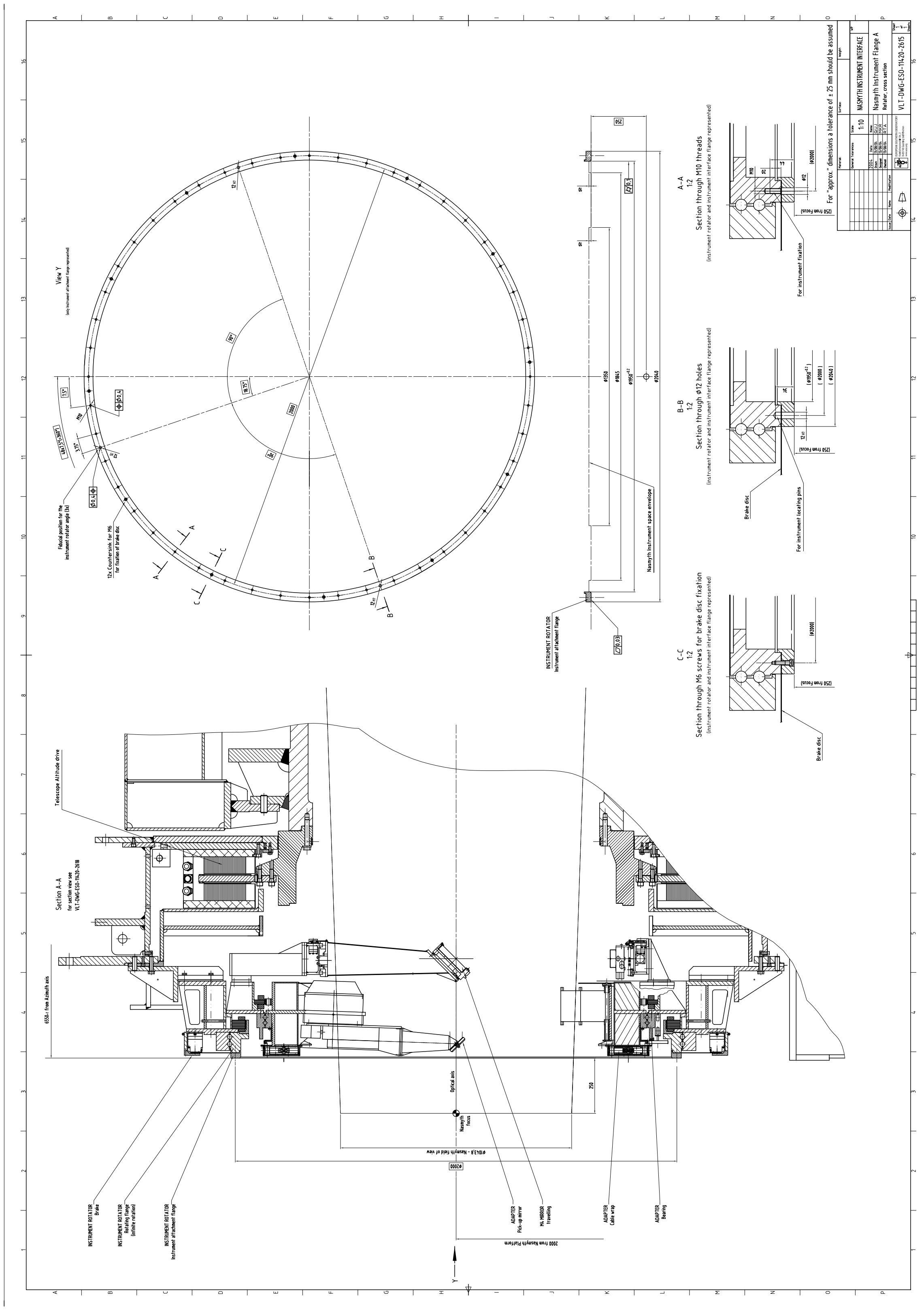

Figure 10: ADWG-N1

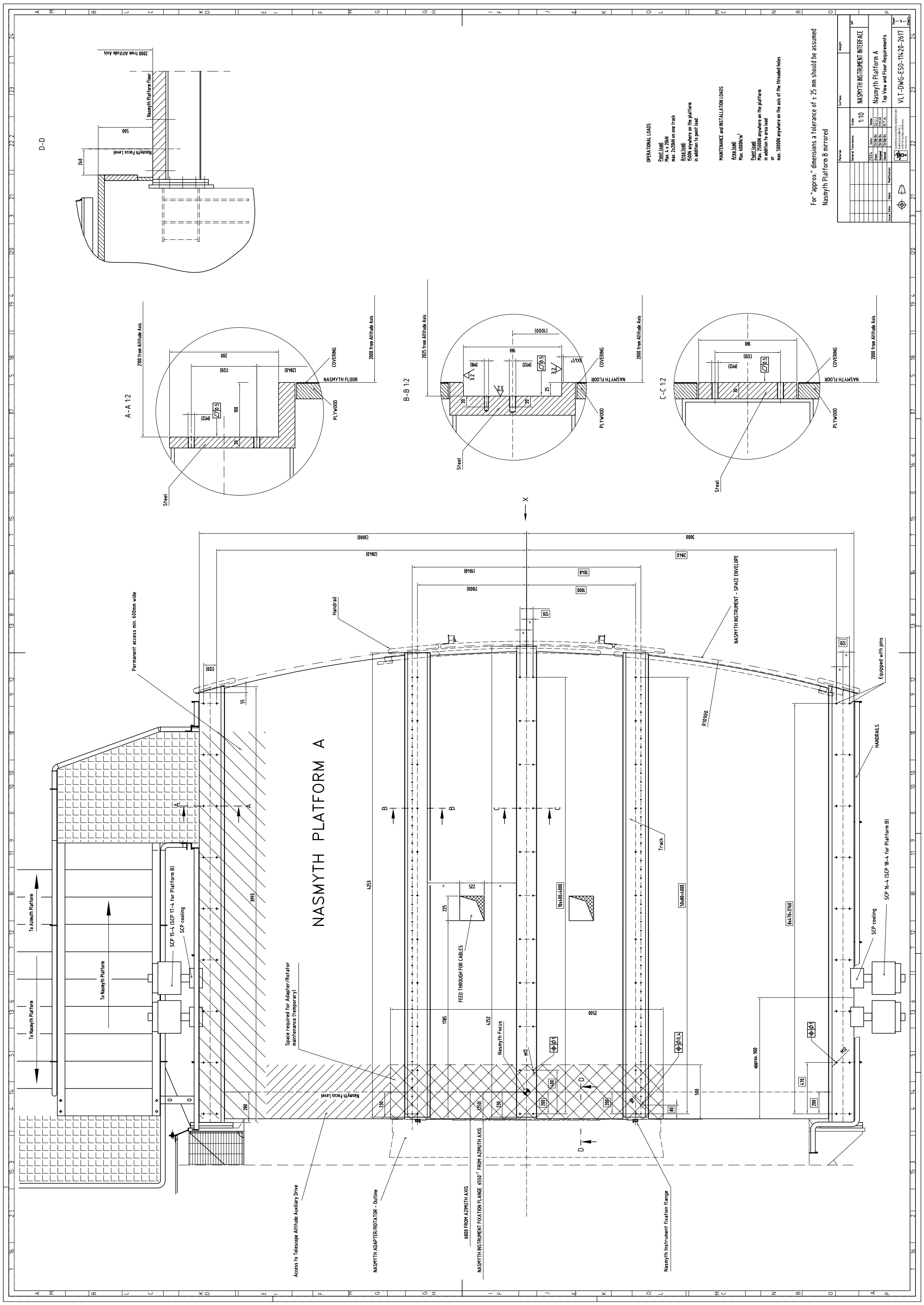

Figure 11: ADWG-N3

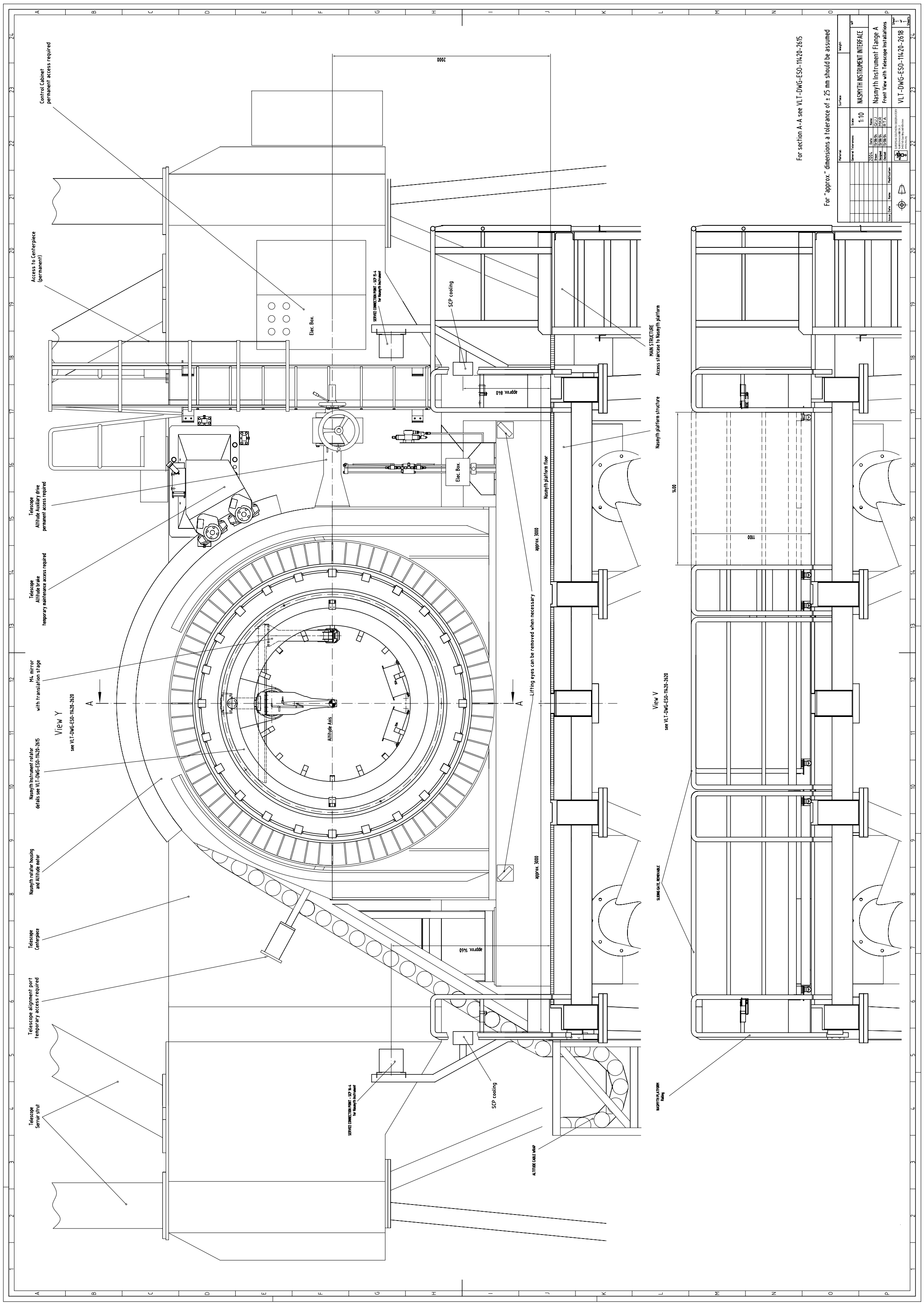

Figure 12: ADWG-N4

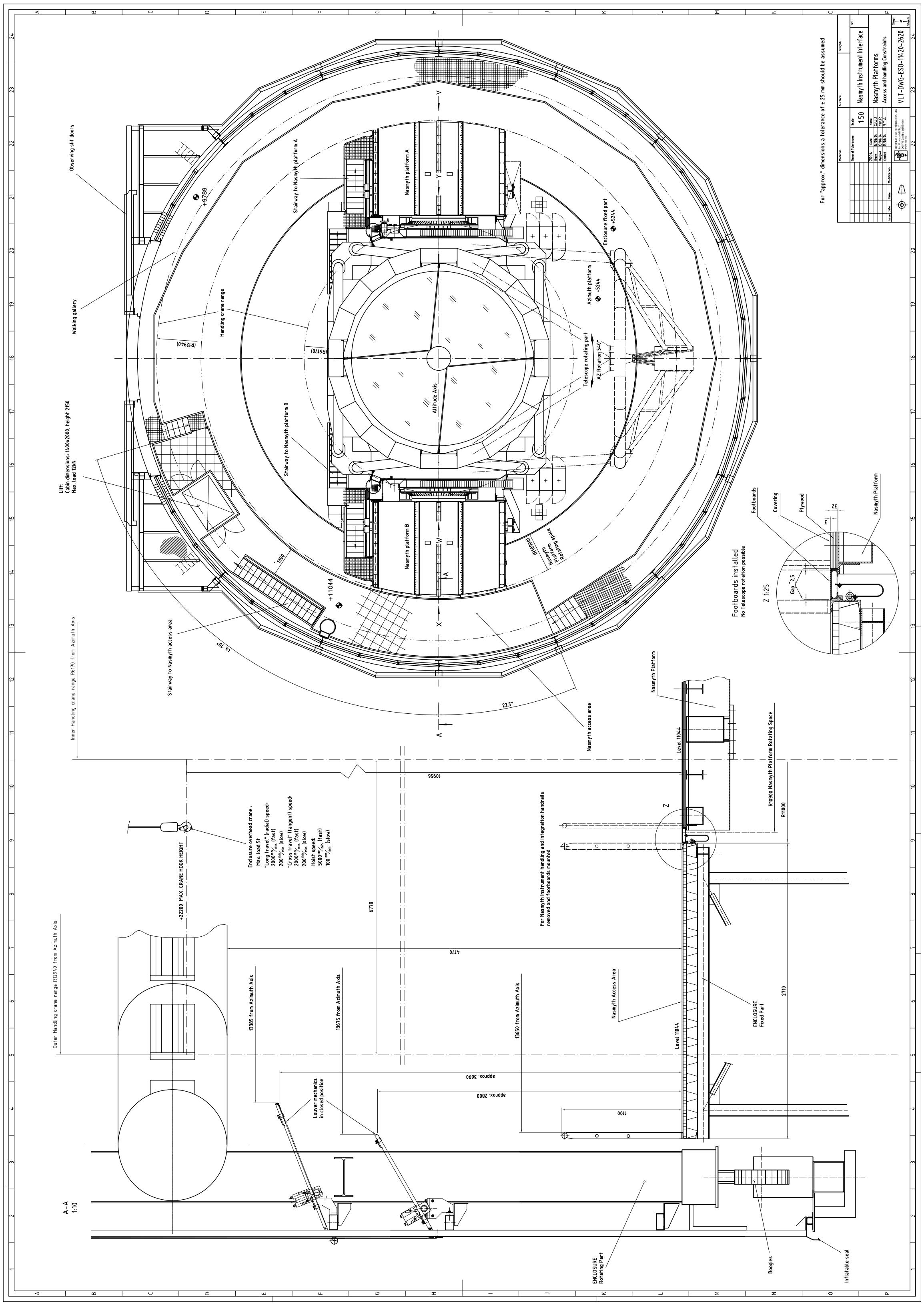

Figure 13: ADWG-N6

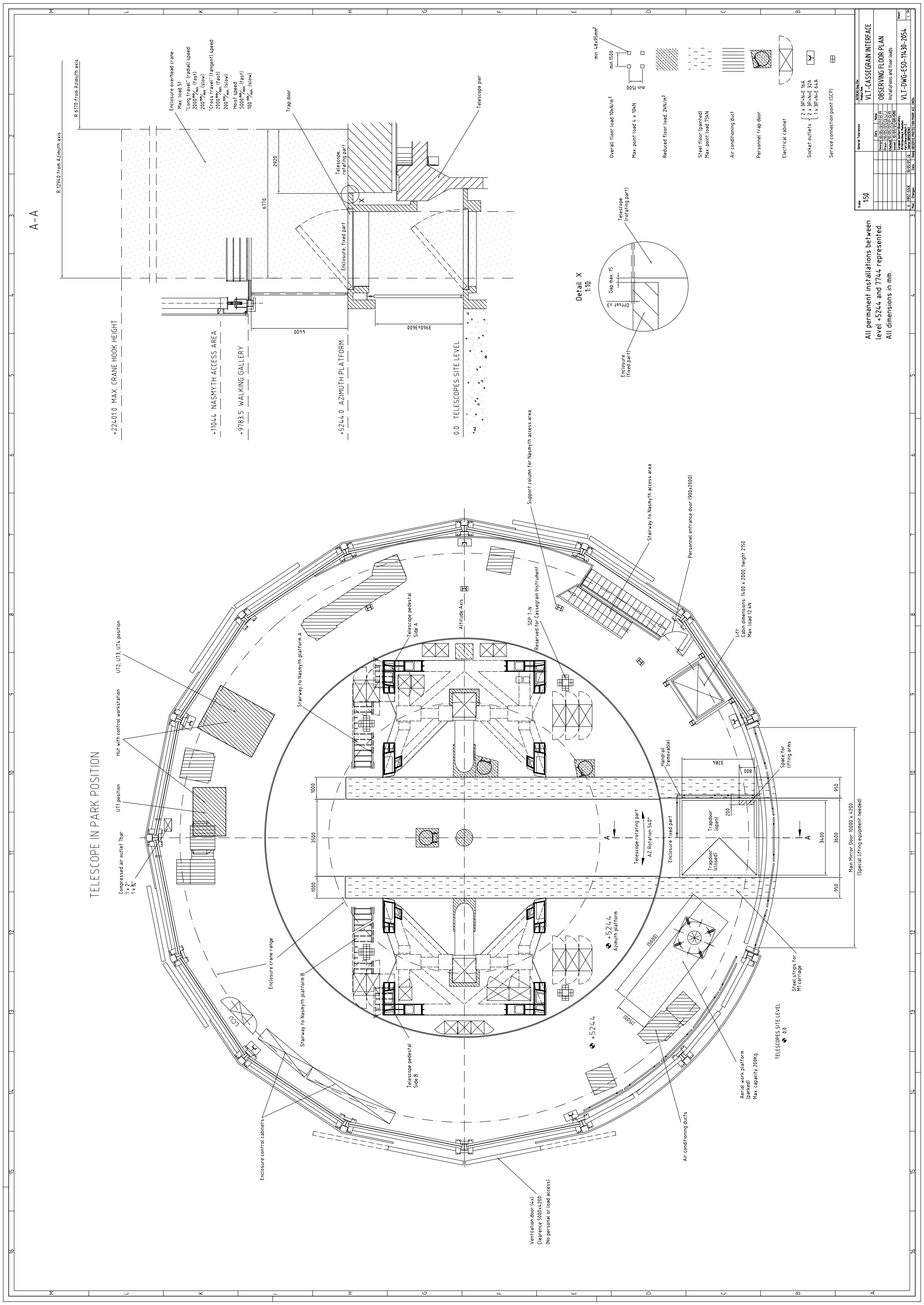

Figure 14: ADWG-C3

B List of Acronyms

AD	Applicable Document
ADWG	Applicable Drawing
AGS	Acquisition/Guide Sensor
ASM	Astronomical Site Monitor
BFD	Back Focal Distance
BOB	Broker of Observation Blocks
CAD	Computer Aided Design
CAS	Central Alarm System
CCD	Charge Coupled Device
DC	Direct Current
DFS	Data Flow System
ESO	European Southern Observatory
IWS	Instrument WorkStation
LAN	Local Area Network
LCU	Local Control Unit
P2PP	Phase 2 Proposal Preparation
RD	Reference Document
RMS	Root Mean Square
SCP	Service Connection Point
SWL	Safe Working Load
TBD	To Be Defined
TCS	Telescope Co-ordination Software
TIM	Time Interface Module
TRS	Time Reference System
TÜV	Technischer Überwachungsverein
UPS	Uninterruptible Power Supply
UT	Unit Telescope
UTC	Coordinated Universal Time
VI	Visitor Instrument
VLT	Very Large Telescope
WFS	WaveFront Sensor

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