Table 3: *Composition of technical project teams at ESO and Trieste Observatory*

| | |
|---|---|
| **ESO** | |
| H. Dekker | Instrument responsible, gratings procurement and instrument testing |
| H. Kotzlowski | Mechanical engineering and technical coordination |
| P. Ballester | MIDAS reduction software |
| S. Deiries | Detector assembly/test |
| B. Delabre | Optics design and procurement |
| S. D'Odorico | Commissioning at the telescope |
| G. Hess | CAD design |
| O. Iwert | CCD detectors |
| J.L. Lizon | Component testing and optomechanical integration/test |
| A. Longinotti | Overall software and liaison with Trieste |
| W. Nees | Instrument control electronics |
| R. Reiss | CCD control electronics |
| E. Zuffanelli | Secretary |
| **Trieste** | |
| P. Santin | Coordination at Trieste and liaison with ESO |
| A. Balestra | Observation Software |
| M.G. Franchini | Observer Support Software |
| C. Vuerli | Maintenance Software |

mounted in the standard ESO dewar that is being developed for a number of VLT instruments while the CCD mosaic requires the development of a dedicated dewar. The dewars will be cooled by a continuous flow of liquid nitrogen that is pumped from a nearby large vessel through flexible LN2 lines. The autonomy time of the system is expected to be on the order of weeks.

## Electronics and Software

While the preceding description is very specific to UVES, the electronics and software architecture will be common to many VLT instruments so the following description reflects the overall control philosophy of the VLT, not just that of UVES. Only a brief description will be given here.

The function control and detector electronics will use intelligent VME-based Local Control Units (LCUs) housed in temperature controlled cabinets outside the enclosure. The control and detector LCUs communicate via the VLT Ethernet LAN with the Instrument Workstation. Its physical location is typically the main VLT control room but it could also be placed next to the instrument during the testing phase.

The main software modules at LCU level are *Instrument Control Software* responsible for communication with the instrument workstation and controlling all instrument functions and *Detector Control Software* to control all detector related LCUs, respectively.

Modules resident in the Instrument Workstation are *Observation Software* which is responsible for controlling observations, from the instrument setup to the storage of the data on tape, *Observer Support Software* which assists the observer to check important parameters relevant to the observation like resolution and expected S/N and *Maintenance Software* to assist the maintenance staff in documenting instrument configuration changes, aligning and doing detailed performance checks. *MIDAS* will be available as well for online data analysis. There will be special MIDAS procedures for image display, calibration and quick-look data analysis.

While in stand-alone mode, these modules will provide for simple tasks like the execution of single observations. Embedded in the whole VLT software, the UVES software will be able to take advantage of many common facilities like the *Sequencer*, which allows to define a sequence of observations corresponding to a complete night off-line, or the *Scheduler*, which allows to switch automatically from one observing programme to another if certain conditions (e.g. seeing) change during the night.

The *VLT User Interface* provides to the user, who may be a service technician, an on-site or remote observer or a service observer, a transparent communication interface with all of these modules at various selectable levels of access authorization, interactivity and automation.

ESO has recently signed an agreement with the Observatory of Trieste under which the latter will contribute 3 man-years in 1993 and 1994 to develop the Observation, Maintenance and Observer Support Software for UVES in collaboration with ESO. The agreement may later be extended to the phase of integration, testing and commissioning of the instrument if this will be in the interest of both parties.

## Project and Science Teams

The composition of the technical project teams at ESO and of the software group at Trieste is given in Table 3.

S. D'Odorico is the instrument scientist at ESO. The project relies also on a team of internal scientists composed of D. Baade, Ph. Crane, G. Mathys, L. Pasquini and J. Wampler for advice on specific scientific/technical issues.

As for the other VLT instruments, UVES has a science team composed by external scientists who are kept informed of the status of the project and whose advice is sought every time a decision has to be taken which has an impact on the scientific capabilities of the instrument. They report to the VLT project scientist J. Beckers. Members of the team are B. Gustafsson (Uppsala), H. Hensberge (Brussels), P. Molaro (Trieste) and P. Nissen (Aarhus).

# The Choice of the Telescope Enclosures for the VLT

*L. ZAGO, ESO*

### 1. Introduction

The final choice of the type of telescope enclosure for the VLT unit telescopes was probably one of the most critical decisions taken in the course of the VLT project up to now.

Back in 1984, at the start of the project, the work on the definition of the VLT enclosures started with the objective to study and design an "open" type of enclosure, in which the telescope would be largely exposed to the undisturbed windflow during observations. This option of envisaging an open-air

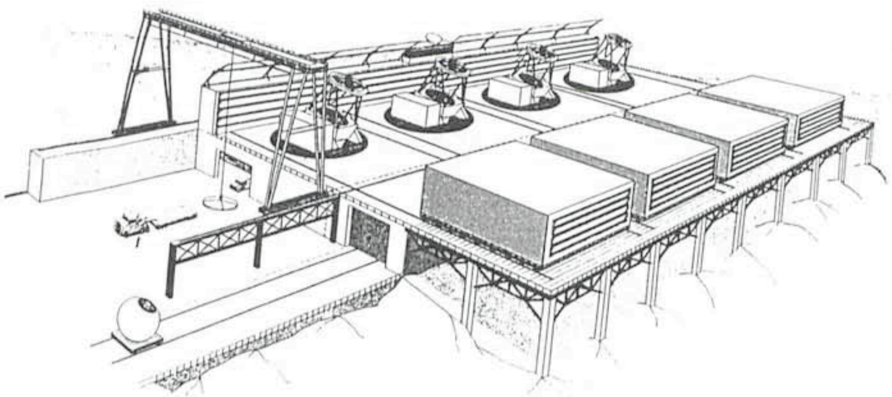


Figure 1: *The first artist's view of the VLT (1984).*

operation of the VLT unit telescopes had been essentially suggested by the favourable experience with the MMT and the NTT, which had broken with the conventional dome concept [1]. Indeed all the evidence available from both traditional and innovative telescope enclosures points to the fact that letting some wind flow on the telescope will reduce or even eliminate dome seeing. Besides the reduction of dome seeing, another main design driver was the objective to drastically lower the cost of the telescope enclosures, so that the entire VLT project could be realized within a budget frame compatible with what was felt were the financial possibilities of the organization.

Thus the very first artist's view of the VLT (Fig. 1) saw the four unit telescopes completely exposed during observations and protected during the day by movable roll-on/off shelters. A large wind screen, nevertheless, had the function of decreasing the wind force on the telescope. For many reasons this first enclosure "concept" was not very practical; however it illustrates well the objectives that were set for the enclosure with respect to the windflow: the enclosure should allow on the telescope as much windflow as required for eliminating local seeing, while limiting the amplitude of wind buffeting to levels acceptable for the optimum tracking performance of the telescope.

The problem of achieving a good tracking performance of the VLT also in presence of strong wind will be solved by the design of a servo-controlled tilting secondary mirror which will provide a dynamic correction of the high frequency telescope oscillations that cannot be reduced by the main tracking control loop acting on the main telescope drives. One could indeed demonstrate that with this system the telescope will be able to achieve a tracking accuracy better than 0.05 arcsec even in the worst wind loading case [2].

The effects of wind buffeting on the primary mirror, however, were not fully quantified until quite late in the VLT development. Although a possible criticality of this aspect had been recognized at an earlier stage, a fact that led to the modified "open" enclosure design in which nevertheless the lower part of the telescope was relatively well protected in a cylindrical recess (Fig. 2), it was thought that the active mirror support system could be made capable of dynamic figuring corrections up to a frequency of the order of 1 Hz [2]. Unfortunately this ambitious objective turned out to be impossible, due in particular to hardware limitations of some components of the mirror supports. Therefore the VLT mirror will have by design only its own rigidity for reacting against wind buffeting and, because of the high mirror aspect ratio, the upper limit specified for wavefront aberrations sets an allowable limit for the pressure fluctuations on the mirror surface of 1 N/m$^2$ rms [3].

This issue ultimately drove the choice of the VLT enclosure towards a type in which the primary mirror could be effectively protected from any wind pressure fluctuation larger than the above-mentioned value.

## 2. The Main Options Investigated for the VLT Enclosures

The development of the enclosures had to be done in parallel with that of the telescope and the mirror support system. Therefore, while the problems related with telescope tracking and buffeting on the primary were analysed in parallel, different enclosure types were the object of detailed feasibility studies. The main options that were considered during this preliminary phase are briefly described here.

### *2.1 The Retractable Enclosure*

This design represented for a long time the baseline for the VLT enclosure. In its final form (Fig. 2) the retractable enclosure consists of a fixed base and a rotating part. The fixed base is made of a metal space frame ring-shaped structure and supports the rotating part on a number of roller bearings. The upper rotating part is made of an approximately cylindrical panel clad space frame, which constitutes a wind shielded re-

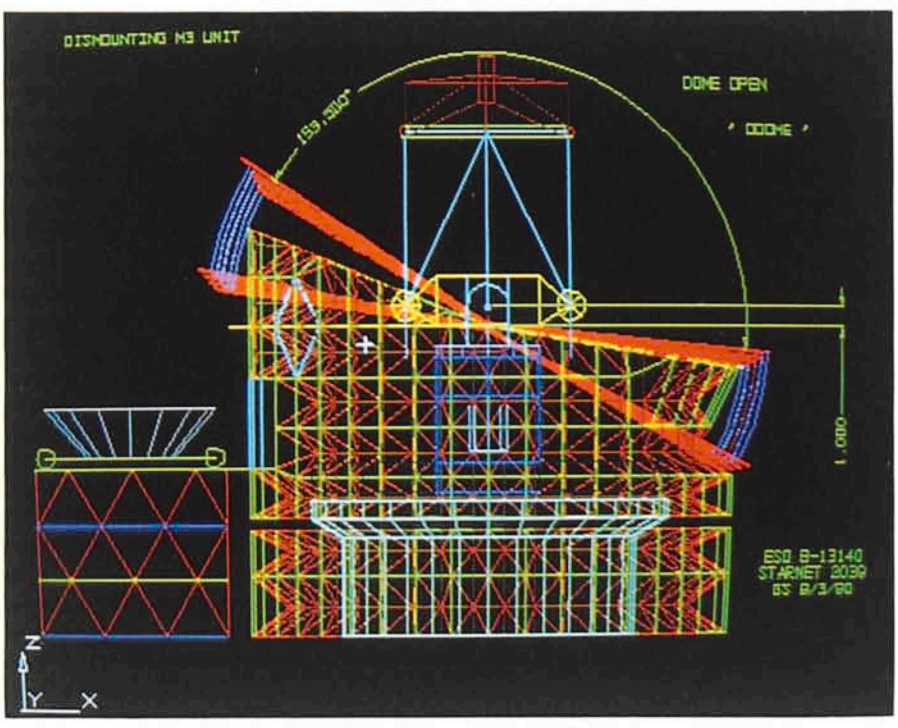
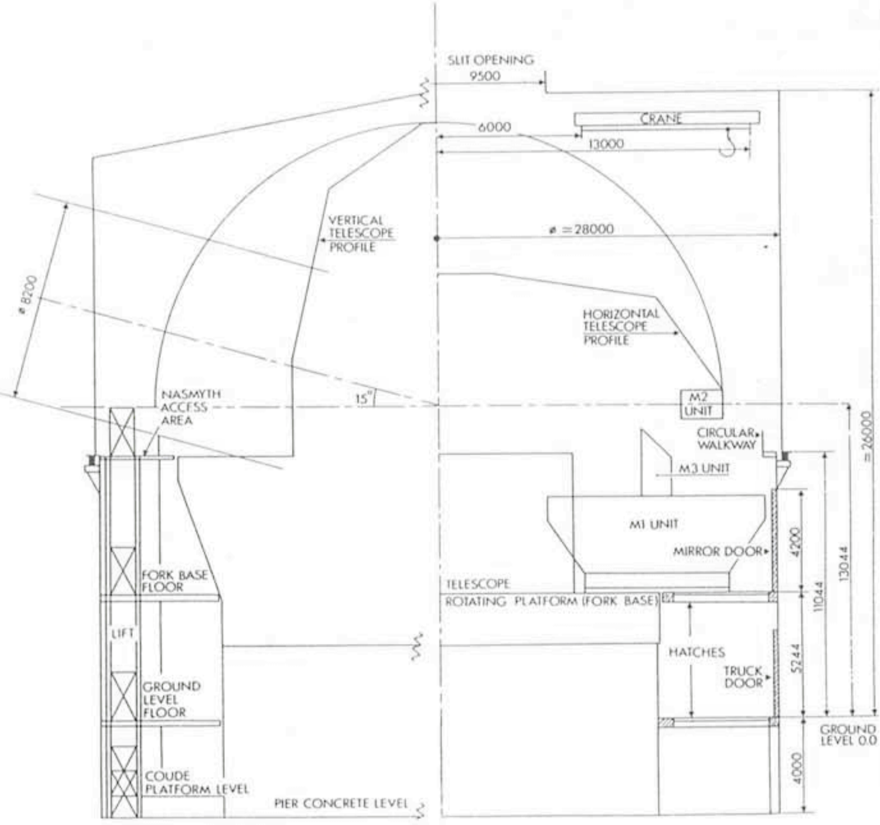



Figure 2: *The retractable enclosure for the VLT (solid shell version).*

## The VLT Enclosure from the User's Standpoint




Schematic cross-section of the VLT enclosure.

Here is a brief description of the selected VLT enclosure, emphasizing the aspects which are likely to be of most interest to future users. A schematic cross-section of the enclosure is shown in the figure. Access for personnel to the enclosure will be either via the underground utility tunnels that connect all the buildings of the telescope area or a normal door at the ground-floor level. Staircases and a lift will connect all floors of the enclosure. A large external door at ground level will allow entry of trucks with large instruments and goods in the so-called ground access room, which covers a quadrant of about 90° at ground level. The rest of the ground floor is made of exposed radial walls which support the metal structure surrounding the telescope room.

At the underground floor a 360° ring of rooms will surround the telescope pier and give access to the pier interior where the coudé instruments will be located. Miscellaneous service equipment will be installed in these rooms, such as the oil pumps for the telescope bearings, but ample space will remain for storage of users' items, which may be quite useful particularly during the installation of instruments. Large equipment items will be lowered down to the underground floor by the dome crane, through a hatch in the floor of the ground access room.

The crane, installed radially just under the roof of the dome, will be the main handling tool for all maintenance operations inside the enclosure and, by rotating the dome, will be able to serve the whole telescope volume except the central region. This crane will be used to mount the Nasmyth adapters and instruments, to install and remove the secondary mirror unit (with the telescope in horizontal position), as well as to lift the tertiary mirror unit before the exit of the primary mirror cell on its way to the aluminization plant. Another hatch will allow the crane to pick up loads from the ground access room into the telescope room.

Inside the telescope room there will be two floor levels. The fork base floor, about 5.2 m above the ground level, will constitute a continuous surface with the rotating azimuth platform of the telescope. Cassegrain instruments will be mounted and accessed on this floor. The upper floor level, 11 m from the ground level, will be continuous with the Nasmyth platforms of the telescope over a 90° quadrant: this area will be the main access way to the Nasmyth instrument for personnel and small equipment. Only a narrow circular walkway will run all along the inner wall of the enclosure, permitting maintenance access to the dome rotation drives and wheels.

During the day and in general when the enclosure is closed, the thermal control system will keep all internal surfaces inside the telescope room at a set temperature close to the predicted value for the coming night: this will prevent, after opening the dome, the rise of convective flows that may affect the seeing quality. This thermal conditioning will be achieved by air cooling and mixing: in order to achieve the desired heat transfer rates with all surfaces, the mixing rate may be set at up to 10 volumes/hour. Therefore, daytime users of the enclosure should expect to find a somewhat (literally) cool working environment, while the noise of fans and air treatment units should not exceed the level usual for rooms equipped with individual air conditioning equipment.

In addition to the thermal control system, the enclosure will include a variety of mechanisms for dome rotation, opening, louvers, etc. All these systems will be managed by a network of computerized controllers linked both to the Telescope Control System network and to the Building Management System (which monitors and administers all service supplies on the site). Therefore the observer will not only be able to operate from his/her control station all the enclosure mechanisms linked to telescope operation (such as dome rotation and slit opening) but will also be able to inquire at any time about the status of all active components of the enclosure.

*L. ZAGO, ESO*

cess in which the lower part of the telescope is contained, topped by a retractable hemispherical dome. Two possibilities for the dome were extensively studied: an inflatable dome made of a pressurized double fabric supported by rigid hoops, or a dome consisting of overlapping shell sections connected along a common axis to the rotating cylindrical part.

Both enclosure versions with the dome in solid shell sections and the inflatable dome were the object of a detailed feasibility study and the inflatable dome design was also thoroughly tested by building a 15-m prototype dome at La Silla (Fig. 3). This dome, erected in 1988, is now planned to be used by Bochum University as the dome for their new Hexapode telescope.

### *2.2 The NTT-type Enclosure*

An alternative enclosure type which was studied in some detail was a scaled-up, simplified version of the NTT building installed at La Silla (Fig. 4). While the other enclosure types limit the observing elevation to 10–15° above the horizon, the NTT-type enclosure would allow observation down to the horizon. It features large, upside down L-shaped doors to cover the observing slit as well as louvers around the periphery of the building, which allow some direct ventilation of the telescope at any azimuth. Like for the NTT, a semi-permeable wind screen can be raised across the slit.

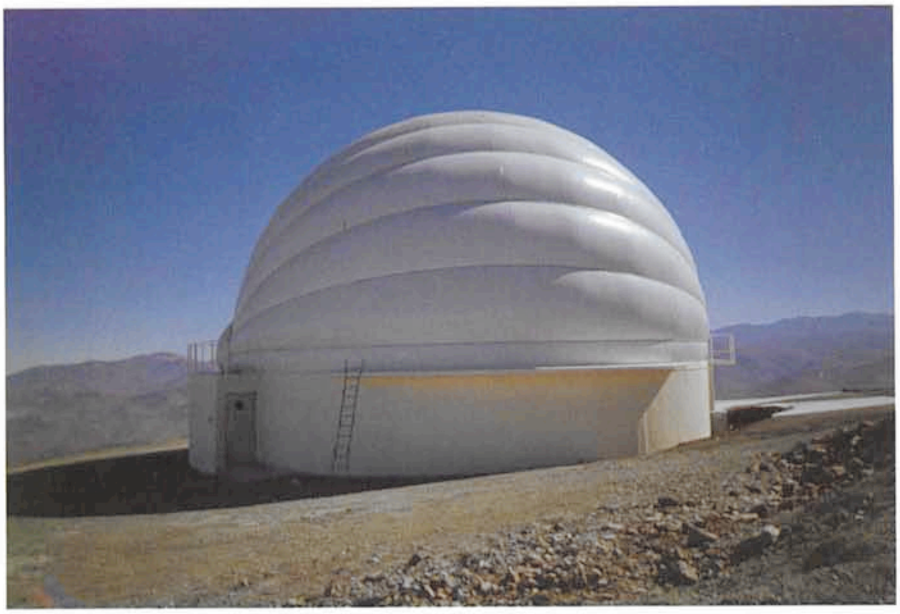


Figure 3: *The 15-m inflatable dome prototype at La Silla.*

The enclosure co-rotates permanently with the telescope but, contrary to the NTT building, the Nasmyth rooms are not separated from the telescope volume, which also results in a considerably simpler and more reliable thermal control system. The disadvantage of an NTT-type enclosure is that it implies a relatively high rotating mass, which causes design constraints to structural and mechanical parts and ultimately makes this solution more expensive than the other ones. This concept was therefore in the end not retained for the VLT.

### *2.3 The Cylindrical Enclosure*

The drawbacks of the NTT-type enclosure with respect to the VLT requirements and the wish for a reasonably conventional alternative to the retractable dome enclosure led to a proposal for a cylindrical enclosure with a two-sloped roof (Fig. 4). Here the design consists of a basement in concrete with a height of about 5 metres from the ground level, which supports a steel structure that encloses and provides access to the telescope. The fixed part of the metal structure rises up to the level of the telescope Nasmyth platform, which simplifies considerably all accesses as compared to the two enclosure types previously described. Near the level of the primary mirror there are some large ventilation openings which, together with the mirror door, may allow some natural ventilation also on the primary mirror.

The rotating part does not include any accessible floors and has essentially the same function as a conventional observatory dome, from which it differs by its optimized structural layout and the presence of large, upside-down L-shaped slit doors quite similar to the NTT-type. The cylindrical shape of the "dome" also allows the easy installation of an internal crane. The two-slit doors are supported on two protuberances of the dome, which also integrate a set of pneumatically activated bars that constitutes a wind screen with different levels of wind permeability across the slit. In the dome itself, a large number of louvers may provide natural ventilation in the entire telescope volume.

## 3. The Final Selection

Both the retractable and the cylindrical enclosures do not present any technical problems and meet all requirements with respect to the protection of the telescope in the closed enclosure. Also the estimated manufacturing and erection costs are too close to be a deciding factor for the choice.

Indeed the main difference between the two types is in the different degree of wind shielding given to the telescope during observation. The cylindrical enclosure can give the telescope a natural ventilation which ranges from full protection to reasonable, but anyway limited air flow across the telescope volume. On the contrary, the retractable enclosure leaves the upper part of the telescope essentially in open air and can limit the wind load on the lower part only up to a certain limit.

Thus the final choice was driven by an analysis of the impact of the local seeing and wind loading effects inside the enclosure on the overall telescope performance. The seeing aspect would clearly favour the retractable enclosure: with some simple design precautions, essentially aimed at reducing radiation cooling during the night, this enclosure would provide a practically seeing free environment to the telescope. Concerning the wind loading aspect, this situation is also favourable with respect to the tracking performance: the active secondary mirror unit would in any case

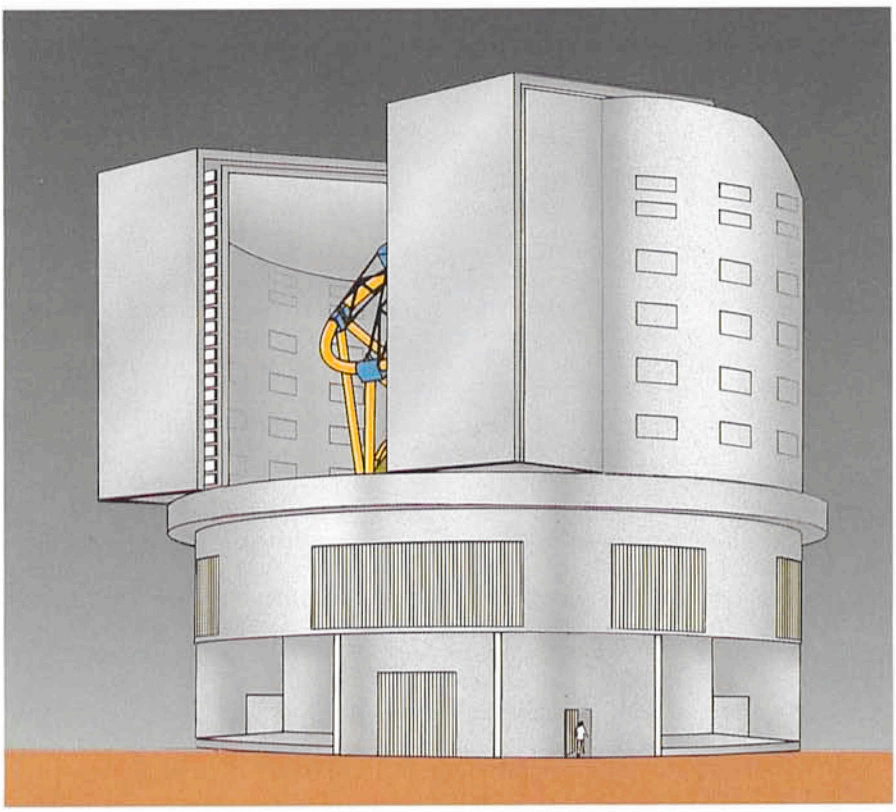


Figure 4: *The cylindrical enclosure for the VLT (drawing by E. Janssen).*

achieve a very good tracking performance even in the worst wind conditions. However, the question is much more critical for the 8-m primary mirror.

Wind tunnel tests were performed to evaluate the air flow patterns in the retractable enclosure: these measurements showed that the primary mirror is located in a recirculation region in which the local flow speed will reach up to 3 m/s when the wind blows outside with a speed of 18 m/s (the maximum operational mean wind speed for the VLT). Air flows of 3 m/s would be considered in other circumstances a light and welcome breeze but here it has to be considered that this will already cause pressure fluctuations on the primary up to about 4.5 $N/m^2$ rms depending on mirror orientation. This level of pressure fluctuations does not cause any problems for conventional 4-m class mirrors, but the aspect ratio of the 8-m VLT primary is so large (as a comparison term, the VLT primary is intrinsically 37 times less rigid than the 3.5-m NTT mirror) that it can maintain an optimal figure only under pressure fluctuations of up to about 1 $N/m^2$ rms. The conclusions of these analyses were rather obvious: because of the high sensitivity of the VLT primary mirrors to wind buffeting, the retractable enclosure may not provide adequate protection in all cases, even if it would probably provide the best seeing conditions.

A "closed" enclosure, that would provide under all wind conditions a good protection of the primary mirror had to be preferred. Nevertheless, in order to achieve an optimal optical performance in all circumstances, it was deemed desirable to keep the possibility of some degree of natural ventilation of the telescope volume. Therefore, the selected cylindrical enclosure includes a number of flexible ventilation possibilities with a semi-permeable wind screen across the slit, louvers in the upper part and some large opening in the lower fixed part. Wind tunnel tests have shown that the critical speed range with respect to pressure fluctuations on the mirror starts already between 1.5 and 2.5 m/s. Therefore, it is clear that the margin for getting some useful natural ventilation is small, although it will exist in some circumstances.

In general, however, the VLT will be able to achieve a consistently low mirror seeing only by means of a tight temperature control of the primary. Computations based on reduced scale experiments and the application of relevant similarity laws indicate that, for instance, if the mirror can be brought at the start of the night within a $\Delta T$ of 0.2° with respect to ambient air and then made to follow the relatively small (on the average) temperature changes during the night that are experienced at Paranal, then the mirror seeing of the VLT will be limited to about 0.1–0.2 arcsec in the worst cases and be reduced to something like 0.03 arcsec, if and when natural ventilation of the primary has been optimally trimmed.

### *References*


[1] Zago L., Environmental effects and enclosure design for large telescopes, Proc. ESO Conf. on Very Large Telescopes and their Instrumentation, pp. 855–866, Garching, March 1988.

[2] Quattri M., Zago L. and Plötz F, Design evolution and performance evaluation of the VLT telescope structure, Proc. ESO Conf. on Very Large Telescopes and their Instrumentation, pp. 127–146, Garching, March 1988.

[3] Noethe L., Cui X. and Stanghellini S., ESO VLT – Primary Mirror Support System, Proc. ESO Conf. on Very Large Telescopes and their Instrumentation, Garching, April 1992.


# Something is Going On in the ESO-Libraries


*U. MICHOLD, ESO-Library, Garching*


The UNICORN
Collection Management System

Did you happen to visit the ESO-Libraries lately? And did you notice the librarians sitting in front of their computer terminals, staring at the screen, sometimes smiling as if in a trance or – on the contrary – sighing deeply? Looking at this unusual scene, you might have wondered what has changed, and then come to the conclusion: There is something going on in the ESO-Libraries.

You are right. Actually, we are in the middle of an important project: the computerization of the ESO-Libraries.

## The Start: Just Pretending

A move from the traditional way of operating a library to an integrated computerized library system had been intended for some time already. Early this year, we eventually found an automated system that meets nearly all our requirements regarding features and functionality, ease of use, and compatibility with the ESO computer environment. The name of the software is Unicorn, and we expect it to turn a myth into a legend, as the vendor claims in his advertisement.

In July 1992 the software was installed on ESO's Sun-machine ns0. From the start, Miguel Albrecht kindly took care of all technical aspects including security and back-ups. At the beginning of August all librarians from Garching and La Silla attended a 5-day training course in Garching. After this intensive learning, we knew how to use all modules of the Unicorn system, and fortunately we were able to test everything on a trial database first. At this time we also started to look for a contractor who could carry out the retrospective conversion of the existing card catalogue.

## Now it's for Real

The "luxury" of being "happy-go-lucky" and doing whatever we liked on the system came to an end in September, when the whole database and every modification we had made so far was deleted. Since then it has been "sink or swim", any mistake we make from now on will have an impact on our own database (although everything regarding setting up policies, entering and deleting data, etc. can be changed later if it turns out not to be the right decision).

Our new colleague, Uwe Glas, took up work in mid-September. In early November we are approaching 2,000 online bibliographic records already! Believe it or not, it's so much fun to see your "own" database grow – and it makes your incredibly proud! Now you might think that it's not the purpose of a library system to make the librarians feel proud – and again you're right. So why all this activity?

## Why it is Worthwhile

An automated library system means a lot of advantages. Let me describe