Enclosure and infrastructures

(Presented by M. Quattri)

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OWL

Contents

- Enclosure
- Site preparation
  - Camp
  - Earth works
  - Roads
  - Foundations
- Infrastructures
  - Hotel
  - Technical buildings
  - Power production plant
  - Mirrors coating plants

Enclosure: main requirements

- Smallest possible enclosed volume and developed surface leaving the telescope free to rotate in the whole range
- Protect the telescope from solar exposure during the day, from extreme environmental conditions like survival wind load, rain or snow
- Keep the inner air volume temperature at a convenient value, so that the telescope structure and optics are close to the thermal equilibrium with the external environment without active air conditioning
- Minimize dome seeing
- Do not create higher frequency turbulence on the telescope

Enclosure baseline (courtesy of CL-MAP)

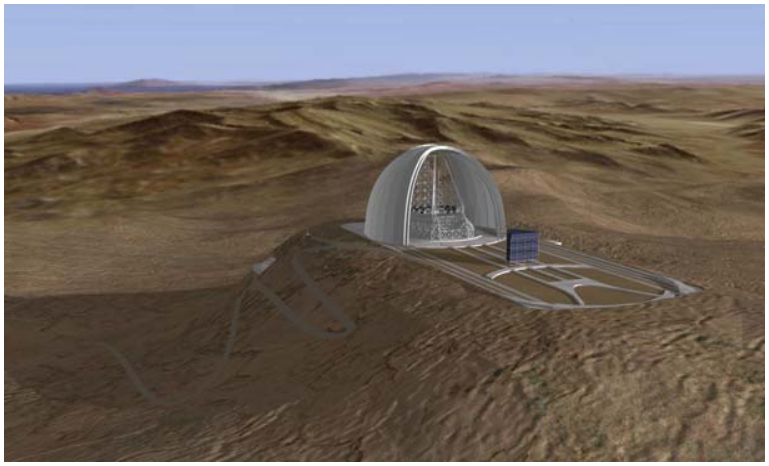
- Sliding Hangar
- Major characteristics:
  Overall dimensions

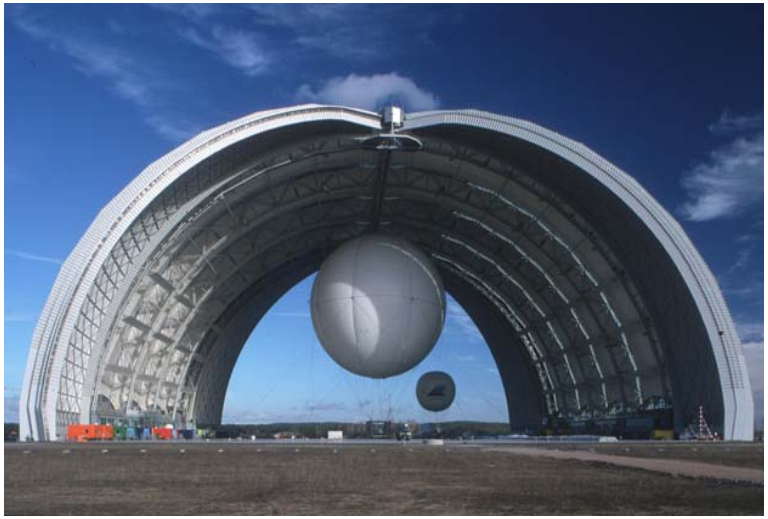
Height	147 m
Length	242 m
Width	242 m
Enclosed volume	4100000 m3
Surface area	102000 m2
Mass	37000 t

Material:

Structure	Mild steel
Cladding	Aluminium sandwich
Pneumatic seal	Polyester

- Inspired by Cargo lifter building built in Brandenburg (110x360x220 HxLxW). OWL enclosure is an evolution of this design.





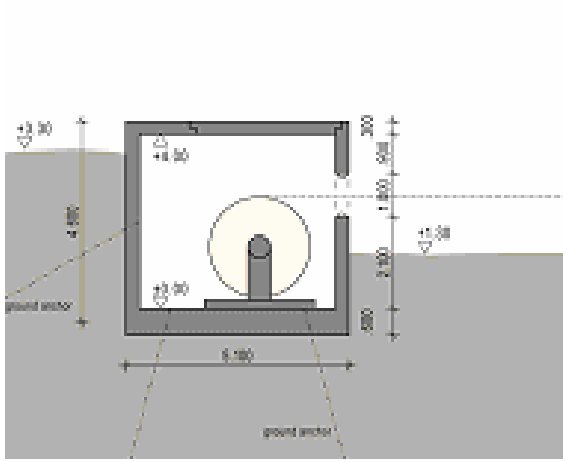
The enclosure structure

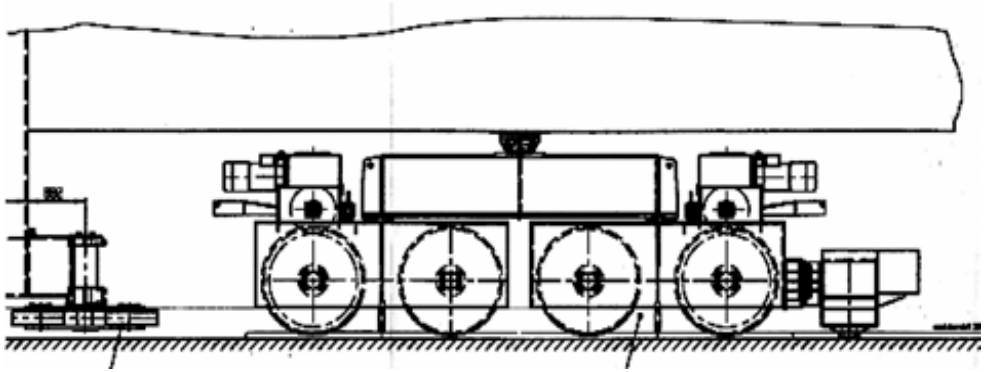
- Structural principle:
  - One main arch hosting the other three arches hinged at the midpoint of the first arch.
  - The three arches rotate to open the enclosure and will be hold by the main arch which will be moved on rails to the night park position
- Dimensioning loads:
  - Survival Wind (67 m/s or 240 km/h)
  - Maximum Likely Earthquake
  - Snow load neglected because snow will be melted (3.5 Mw needed)

Mechanical and functional performance

Maximum deflection under gravity load	150 mm
Maximum deflection under operational wind load	200 mm
Maximum deflection under OBE	300 mm
Maximum deflection under survival wind load	450 mm
Maximum deflection under MLE	550 mm
First eigenfrequency	0.4 Hz
Maximum displacement speed	0.8 m/s
Minimum time for opening arches	15 min.
Distance between day and night parking position	410 m
Arches drive system	bogies
Enclosure drive system	Winches and cables

Enclosure and doors (arches) drives

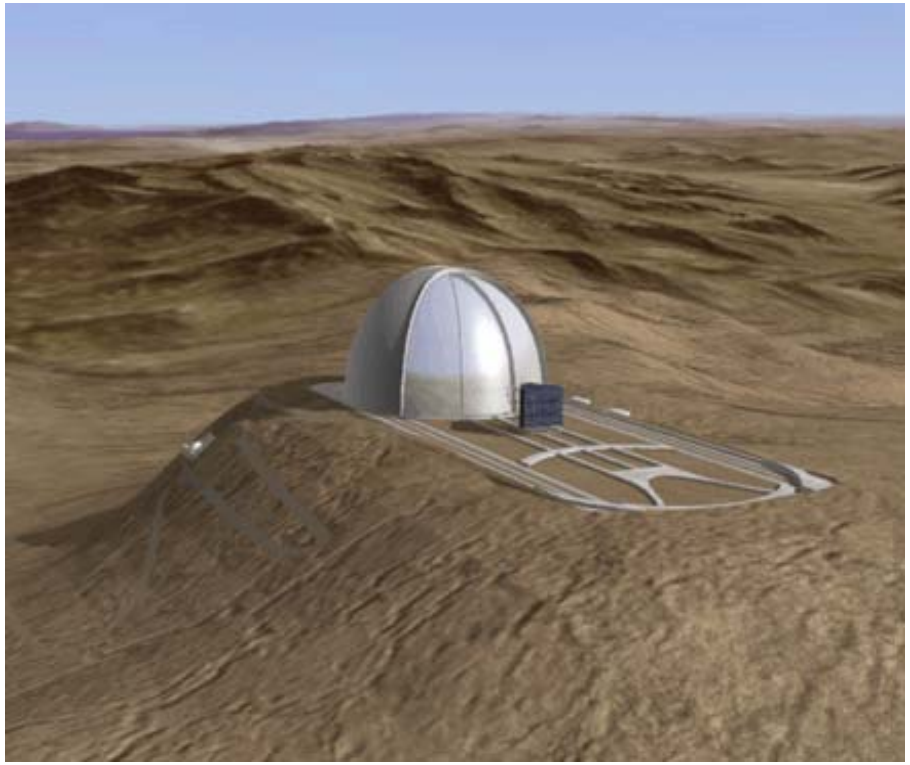




- The main drive is conceived as a cable drive.
- The three smaller arches (doors) will be moved on bogies.
- Required power to move against maximum operational wind (27 m/s or 100 km/h) is 5.3 MW.

Enclosure opening and closing sequence

- Opening/Closing sequence (courtesy of CL-MAP)
  - Opening central arch to allow retracting of the mirrors covers
  - Opening of the other two arches to allow enclosure to be moved away
  - Move open enclosure to night parking position (max. speed 2.8 km/h)
  - Emergency shut down lasts about 35 minutes.



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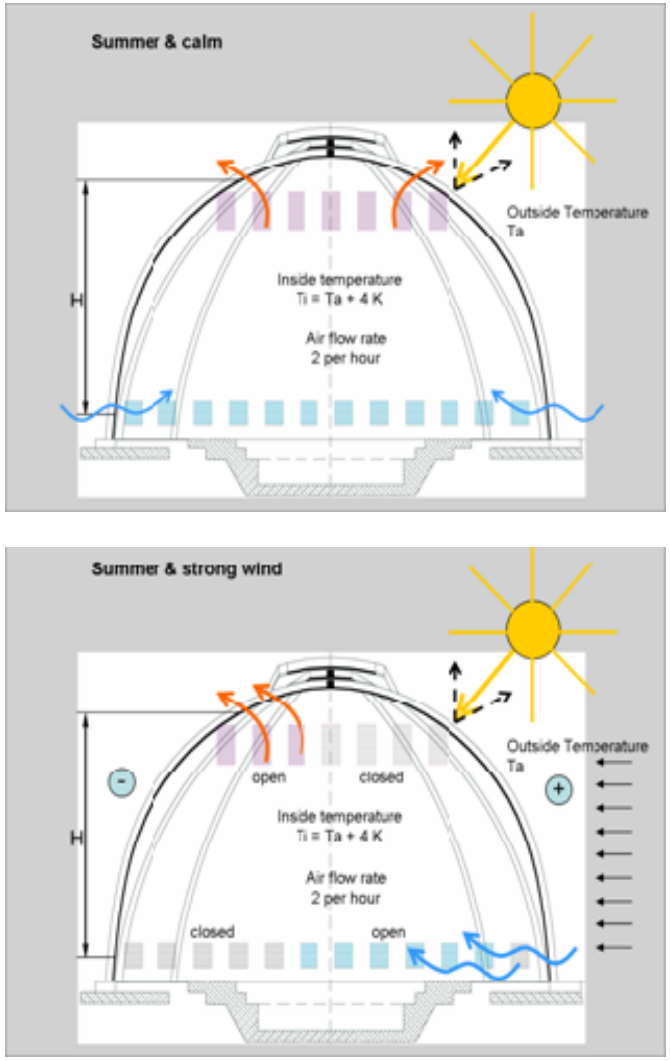
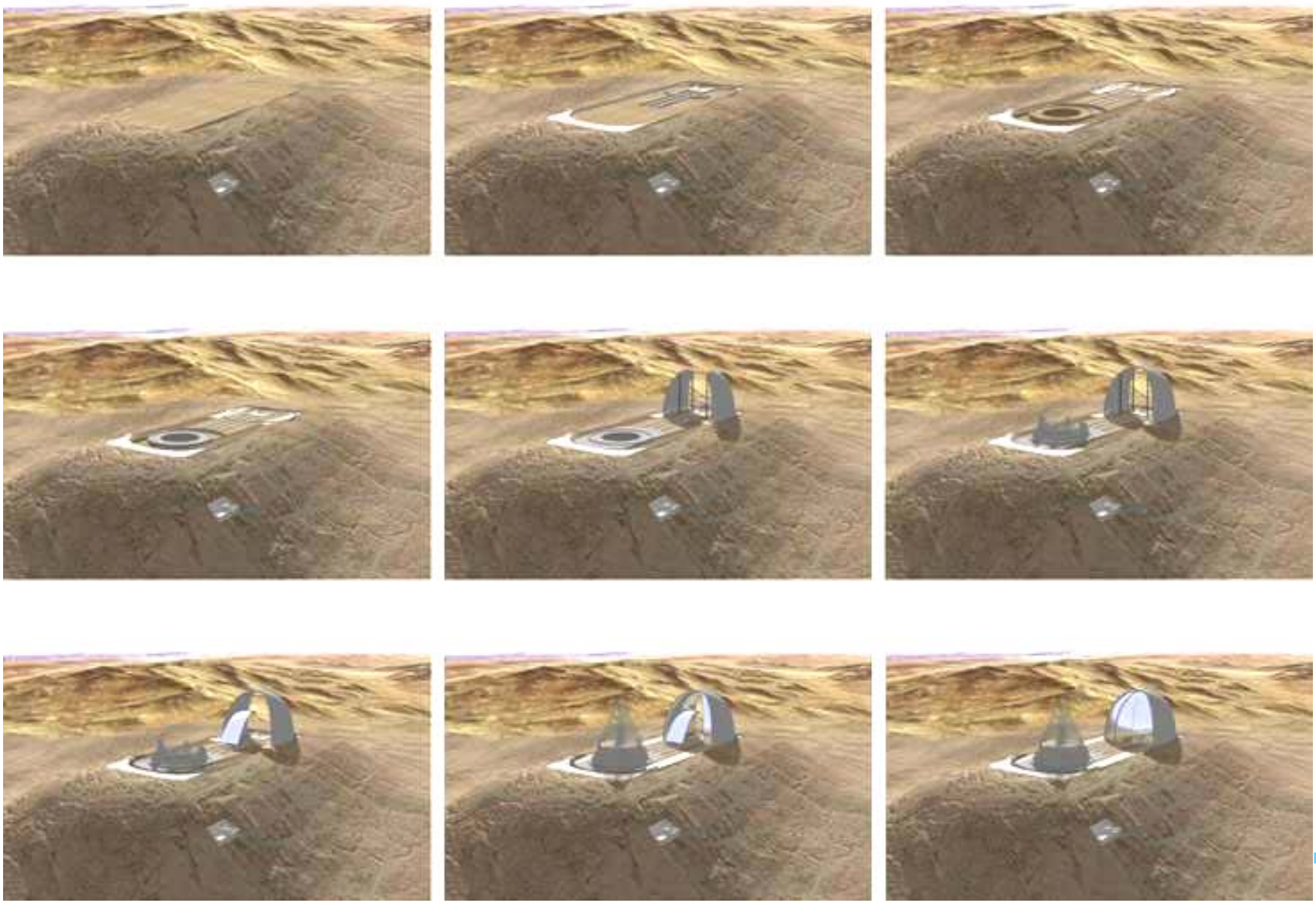
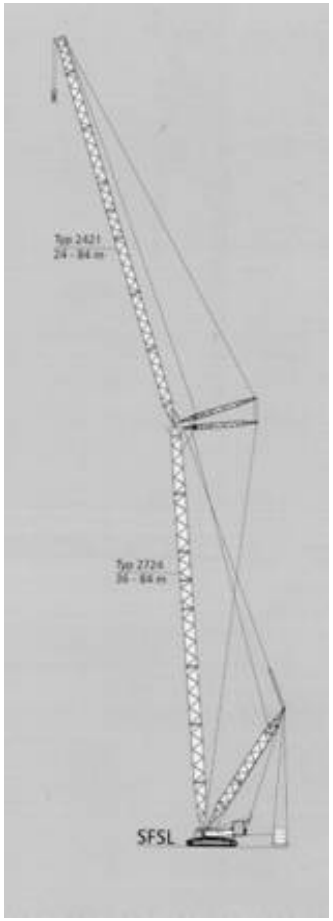
- Internal volume cooling is obtained with natural convection triggered by chimney effect
- Estimated solar radiation is in the order of 12 MW.
- The height of the enclosure and a correct dimensioning of the openings at the bottom and at the top of the enclosure may draft up to 1100 m^3/s therefore about 1 enclosure volume /h with heat removal capacity of about 12 MW.



Construction sequence



Building the enclosure: the cranes

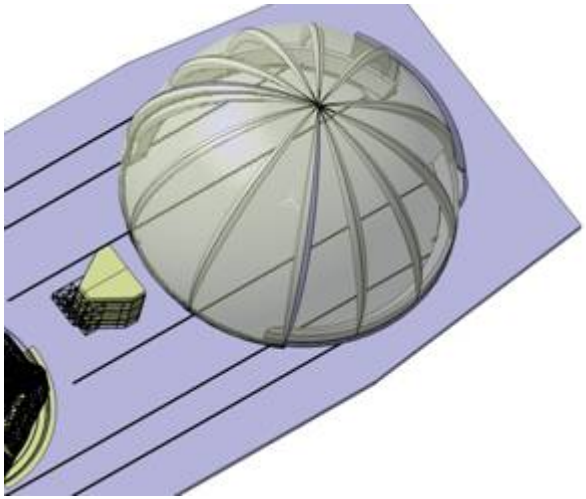


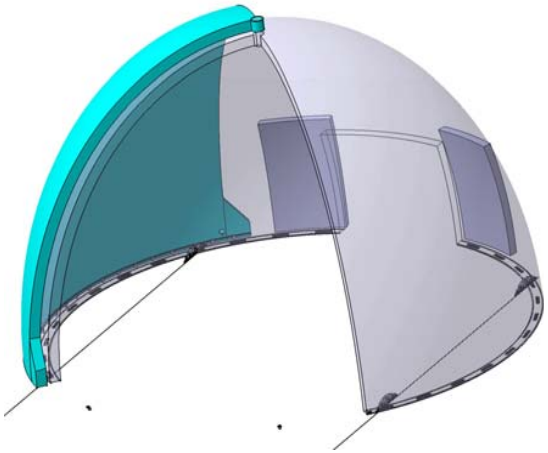
(168 m max. height)

Building the enclosure: same sequence for Cargolifter (Brandenburg)

Alternative designs: same concept, different technology

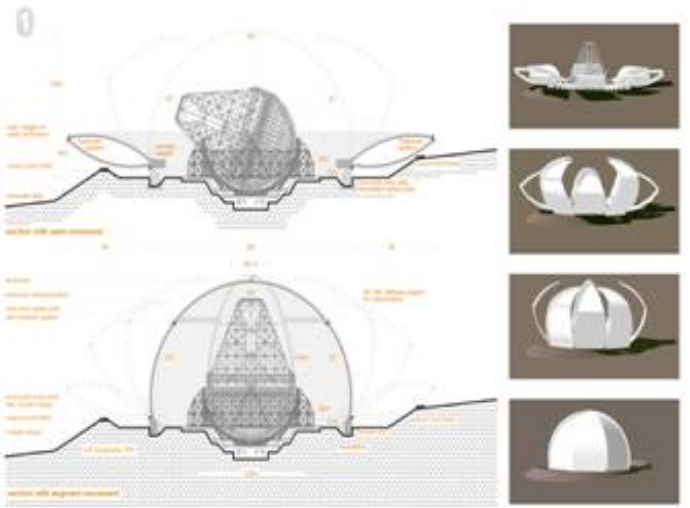
- The same concept using Tensairity® technology (Airlight SA Switzerland).
  - The structures are reinforced and continuously supported by low pressure air cushions.
  - The membranes stabilize the structure and the structural steel needed is about 5 to 8 times less than with classical structures (no buckling).
  - Especially advantageous for spans larger than 30-50 m.

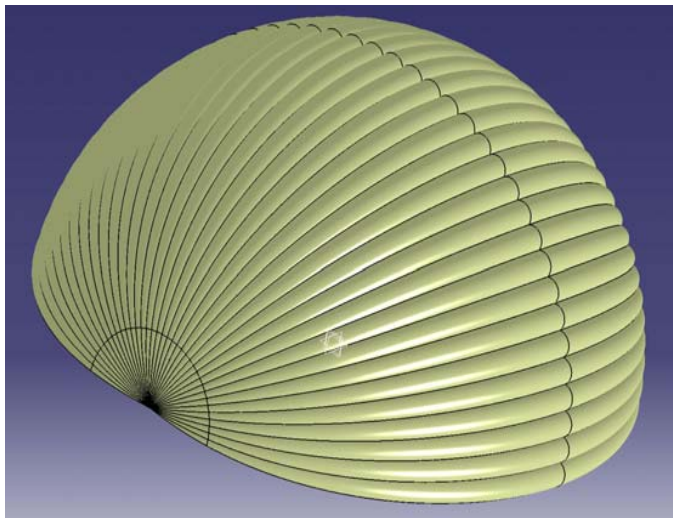




Alternative designs: different concepts

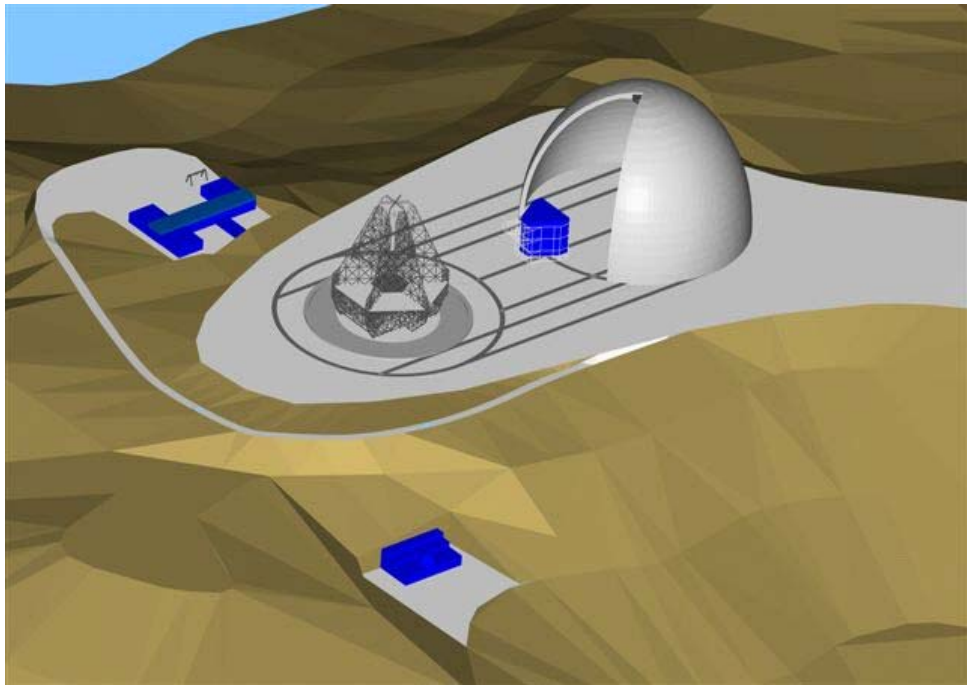
- Alternatives
  - Petals like enclosure
  - Tensairity® radome like enclosure
  - Both would require prototyping to validate on smaller scale the concept (30m diameter?)
  - Other concepts will be evaluated.





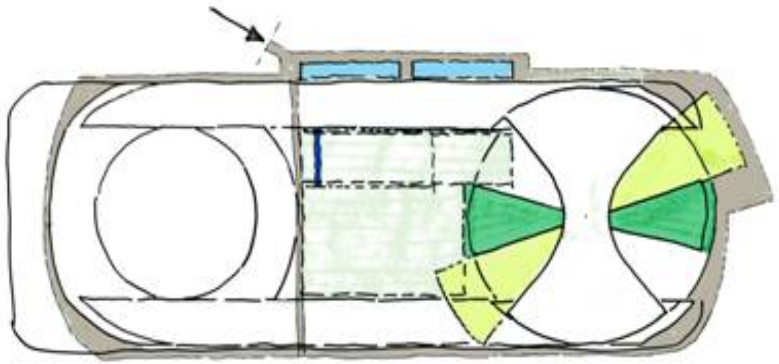
Site preparation: flattening the area and building access roads

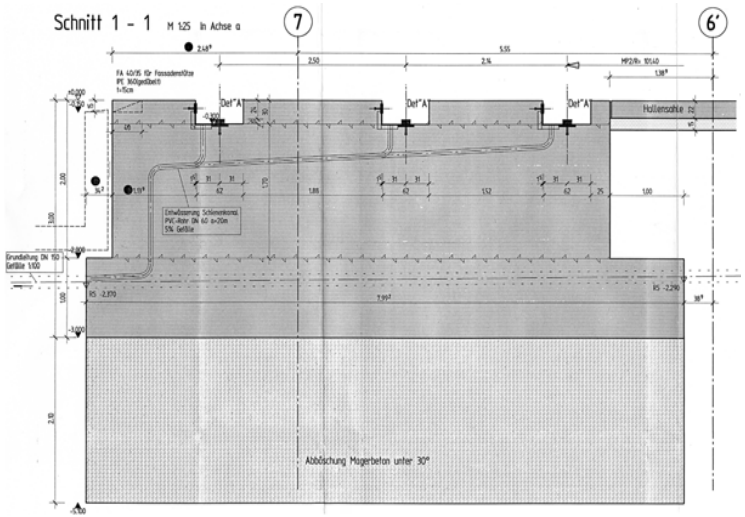
- Concept based on the topography of two sites with different environmental conditions and soil geo-mechanical conditions
- Preparation of telescope platform: blasting of about 1.9 to 3.3 million cubic meter according to the assumptions and the site
- Roads to be developed between 3 to 15 km



Preparation of the construction site and foundations works

- An area of about 170000 m^2 will be prepared to pour the foundations for telescope and enclosure
- About 170000m^3 of concrete reinforced with 12000 t of steel will be poured
- Drainage channels will be built to evacuate rain



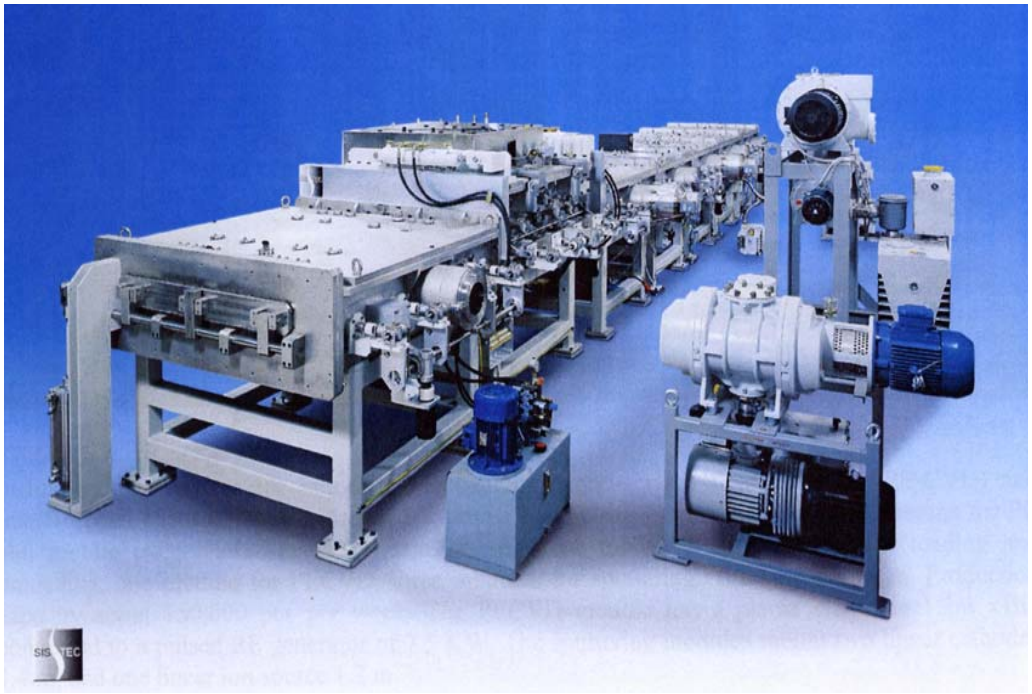


Auxiliary buildings

- Technical buildings (laboratories, mirror maintenance building, assembly halls) for about 4600 m^2
- Offices for about 1900 m^2
- Telescope control room 200 m^2
- Personnel accommodation building as in Paranal

Mirrors : coating facilities

- For mirrors of the corrector same coating plant as for 8.2 m VLT
- For segments, up to 5 recoating per day, automatic process machine



Installations and special fluids distribution

- Air Conditioning of those volumes which encompass instruments and optics for a total of about 120000 m^3 (equivalent to the total volume conditioned at VLT)

- Power plant based on internal combustion engines.
  - Maximum demand about 9 MW (about 11 MVA)
  - Choice to be taken after decision on the site and specialized study

- Liquid N and He will be distributed on the telescope and in the labs (try to avoid close cycle cooler to avoid vibration sources on telescope)

Enclosure and infrastructure: conclusions

- In spite of the unusual dimensions viable concepts for the enclosure could be defined which meet the requirements, although unprecedented requirements are put on the site topography
- In the next phase the baseline concepts and the alternatives will be thoroughly studied to allow a trade off considering all the possible implications on OWL observatory
- Auxiliary building and installations do not pose technical problems to be built