The CTA reference sites and their implementation (SDEV)

SSC Meeting,- April 5th, 2013

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and

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PO = CTA Project Office

SDEV milestones and tasks

- **PHASE 1 : Define generic infrastructures and costs – now ending**
  - Implement the CTA infrastructures on a virtual ideal generic site
  - Define the infrastructures, estimate costs & risks

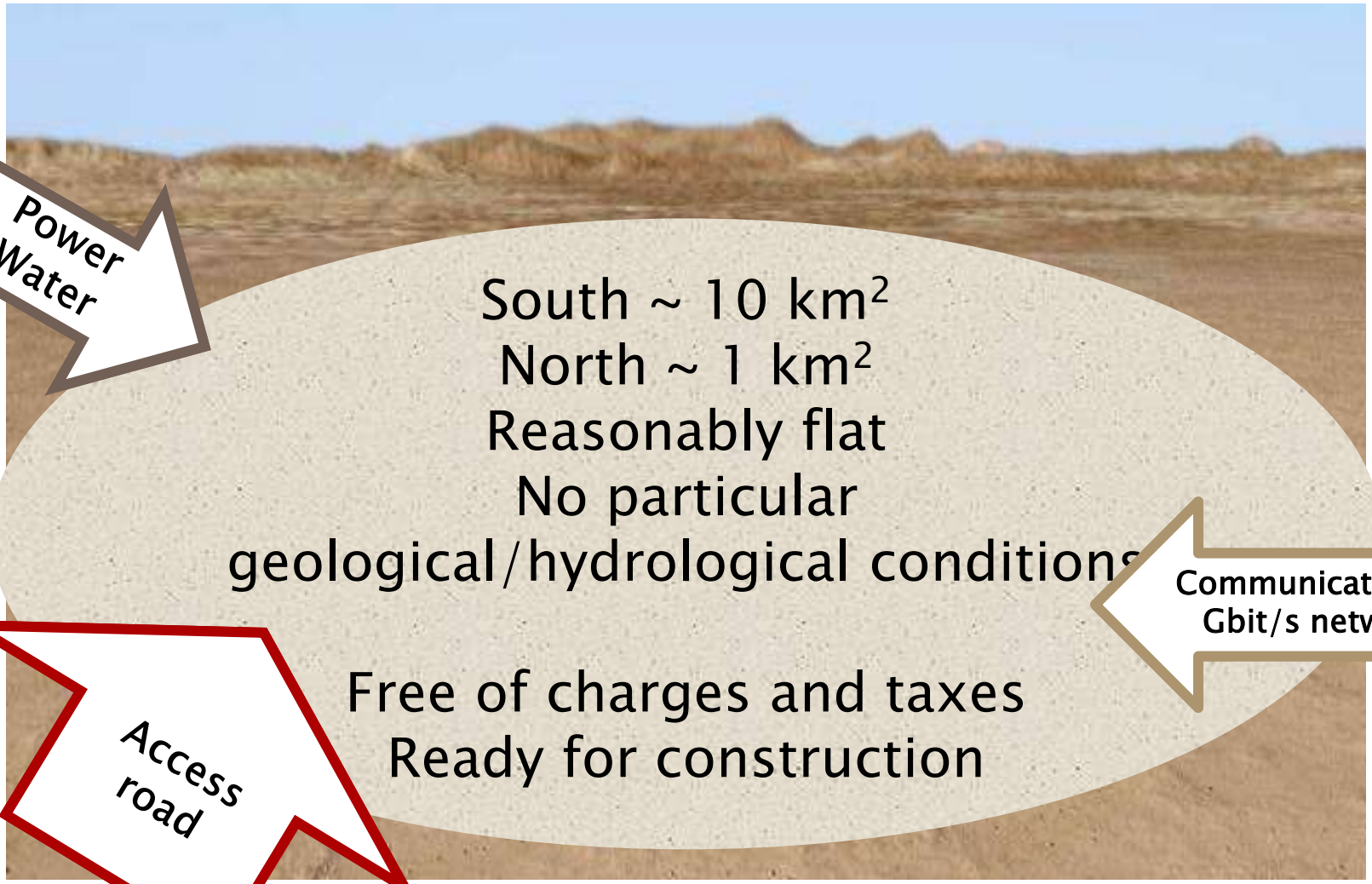
- **PHASE 2 : Implement on the candidate sites – now starting → site selection**
  - Evaluate departures when implementing on candidate sites
    - Design changes;
    - Extra costs;
    - Specific risks.
  - Submit results to the decision body(ies)

- **PHASE 3 : Detailed implementation on remaining sites – in 2014**

The infrastructure definition

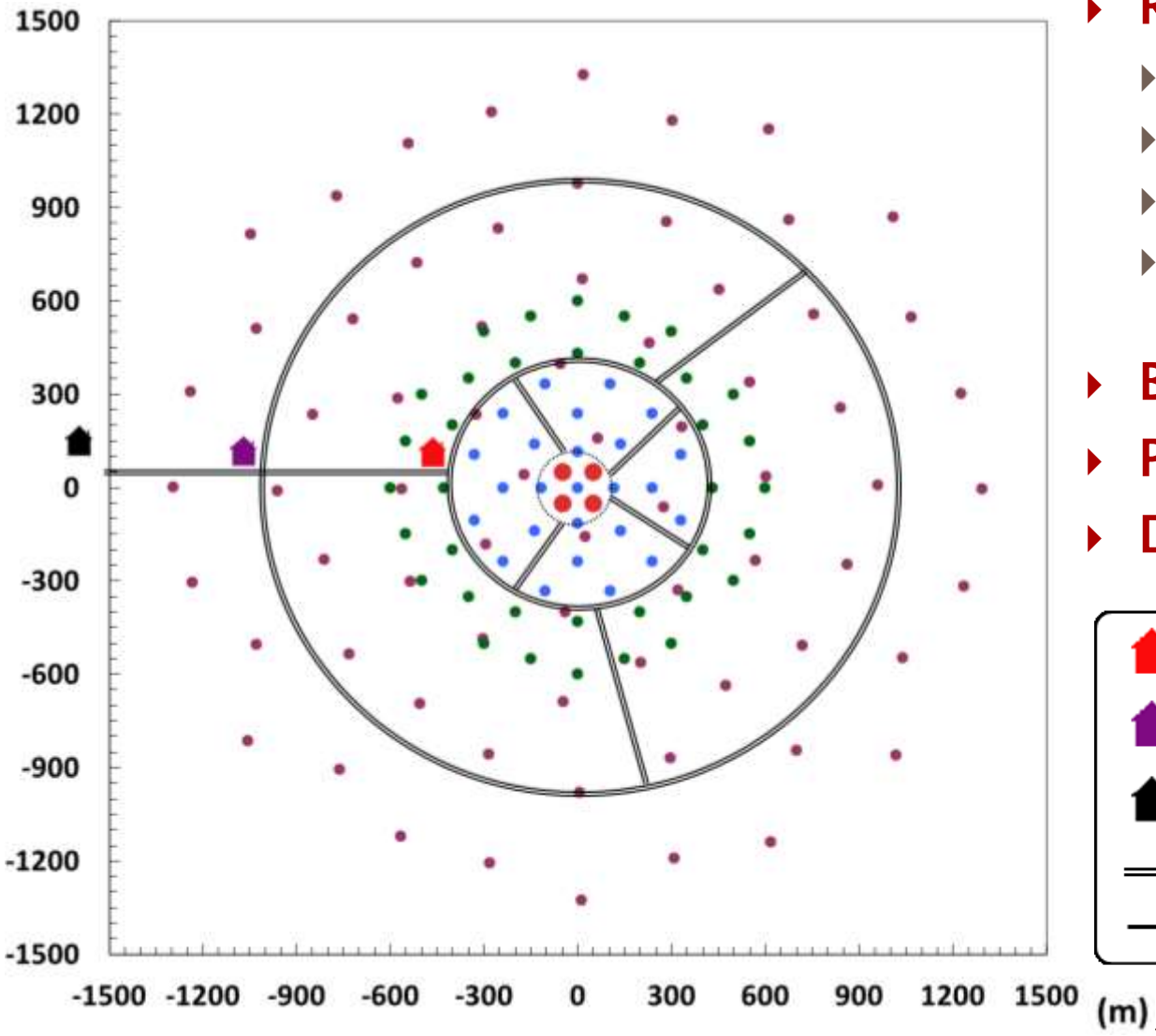
- **Mostly subcontracted to a private company**
  - Naulsen Prei (http://naulsenprei.free.fr)
- **Infrastructure definition**
  - Interactions within CTA & previous IACT experience
  - Previous technical infrastructure experiences
    - Soleil synchrotron & CEA Saclay, France
  - Very detailed PBS (hidden cost tracking)
- **Costing**
  - Used to estimate relative importance of components
  - Standard European cost (France) from contacts with
    - Civil Engineers (Dumez et Borie)
    - Electric companies (Schneider Electric, Nexan)
    - Other various sources …
  - Includes manpower
  - No VAT

The generic site definition

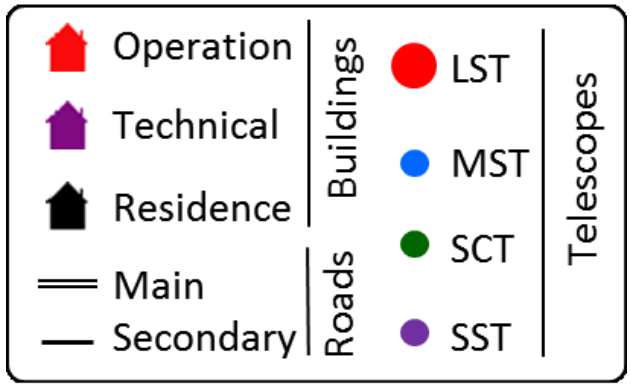


South

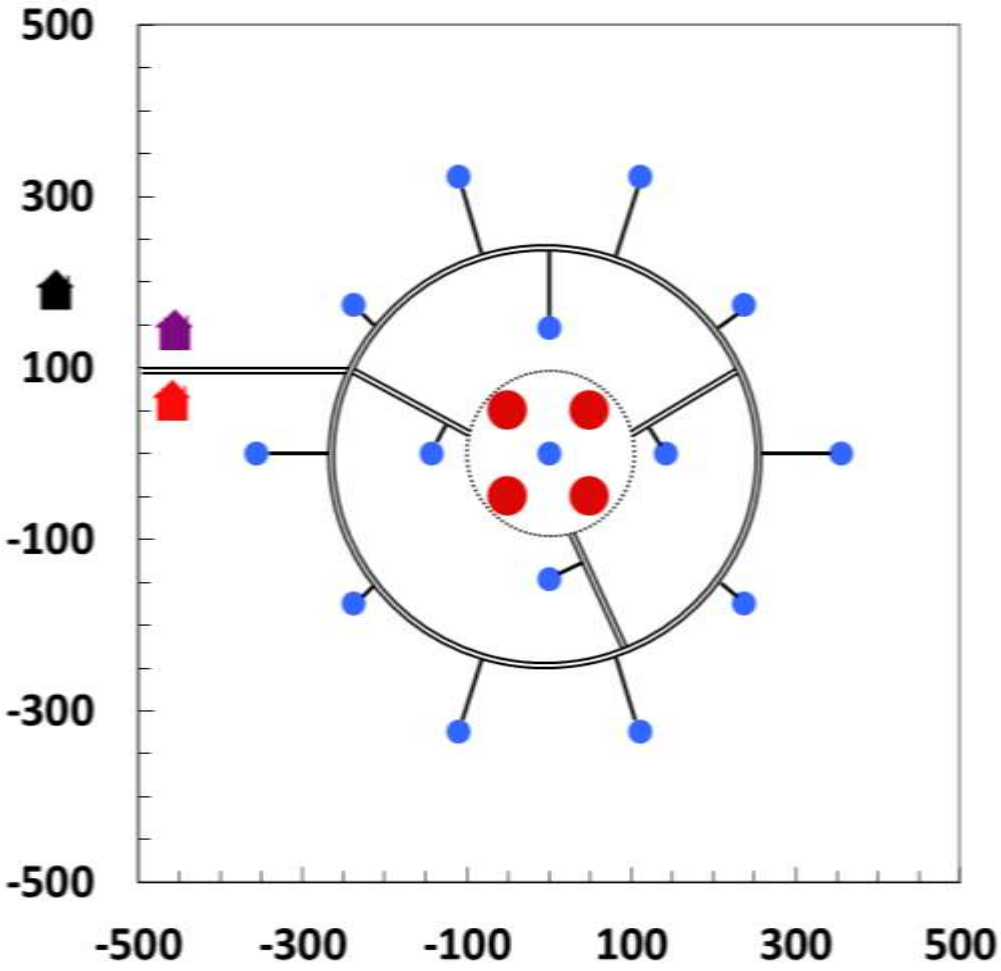
4 LST, 25 MST, 70 SST, 36 SCT



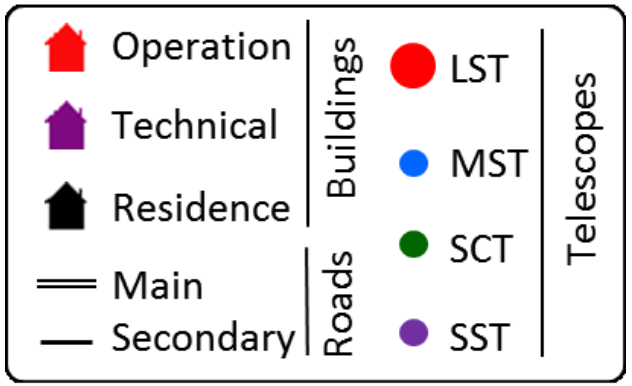
- **Roads and parking**
  - Main : 13.2 km
  - Secondary : 17.2 km
  - Parking : 4400 m^2
  - Central area : 30000 m^2
- **Buildings X 3**
- **Power : 4 MW peak**
- **Data Network : 1 Gbit/s**



North
4 LST, 15 MST



- **Roads and parking**
  - Main : 3.0 km
  - Secondary : 0.8 km
  - Parking :2000 m^2
  - Central area : 30000 m^2
- **Buildings x 3**
- **Power : 2 MW peak**
- **Data Network : 1 Gbit/s**



Telescope foundations & roads

- **Landscaping**
  - Land preparation
    - 10 cm over 30% of the site surface
  - Telescope foundation excavation
  - Trenches and pipes

South	South
6.2 M€	0.8 M€

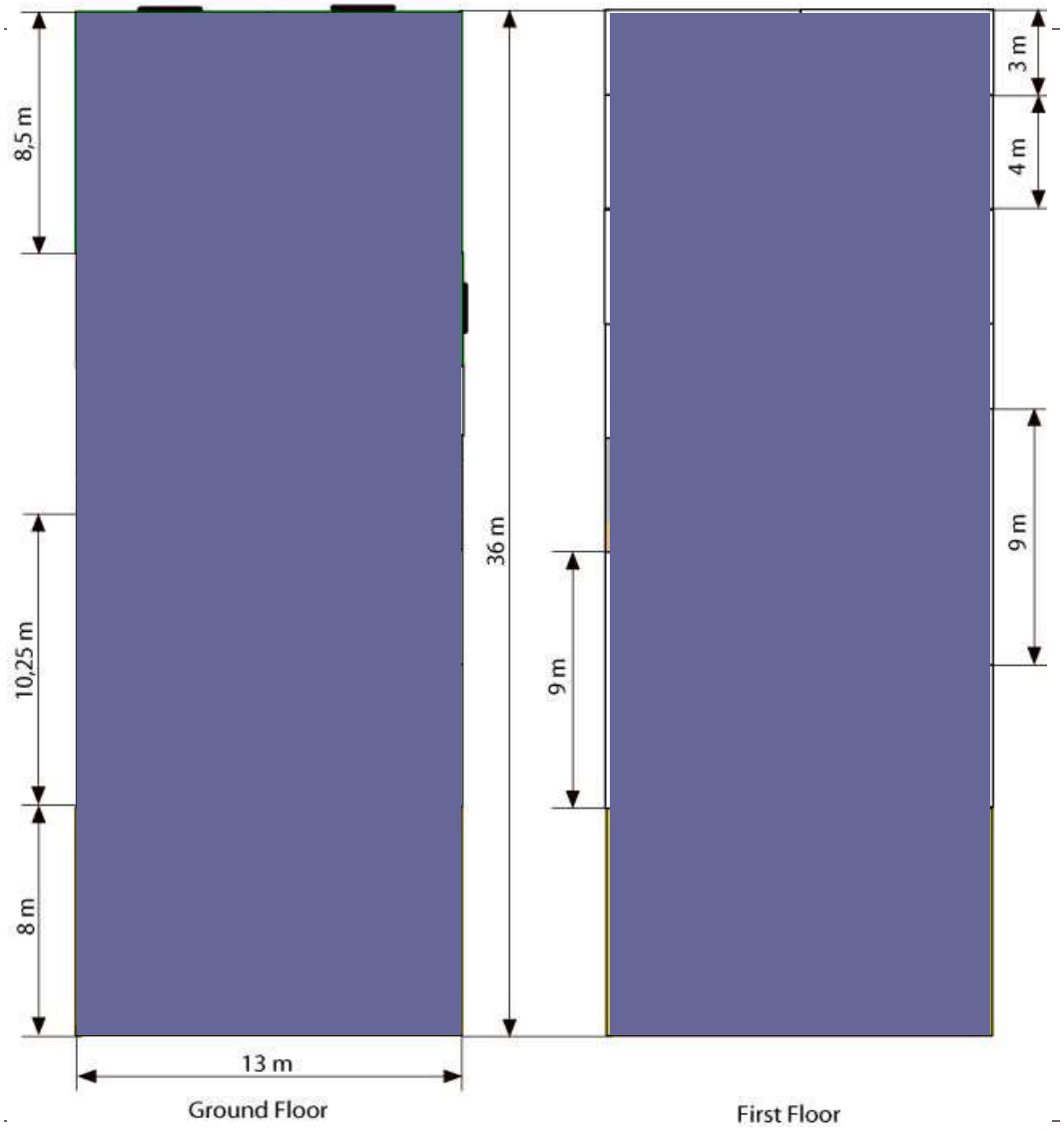
- **Roads, parking, fences**

South	North
7.8 M€	1.7 M€

- **Telescope foundations**
  - Reinforced concrete
  - Computed for a “usual” soil
    - Might differ from one site to another
    - Might be adapted to seismicity

South	North
4.4 M€	1.3 M€

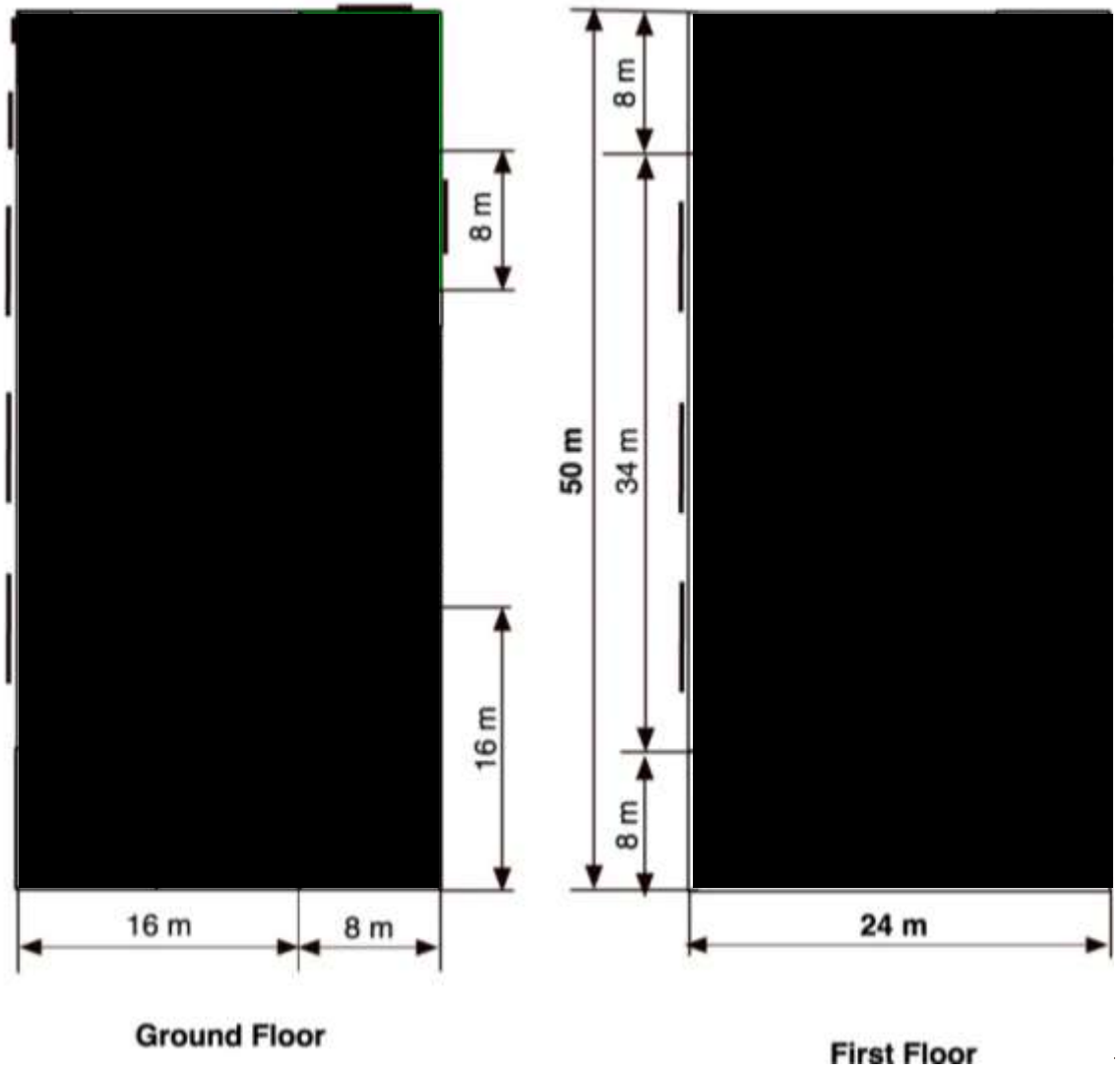
Operation building

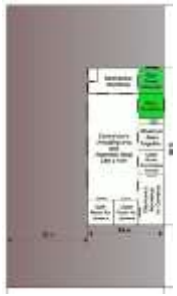


- 12-15 persons
- 832 m2
- Consumption depends on computers
  - Assumed 100 kW

South	North
2,0 M€	2,0 M€

Technical building

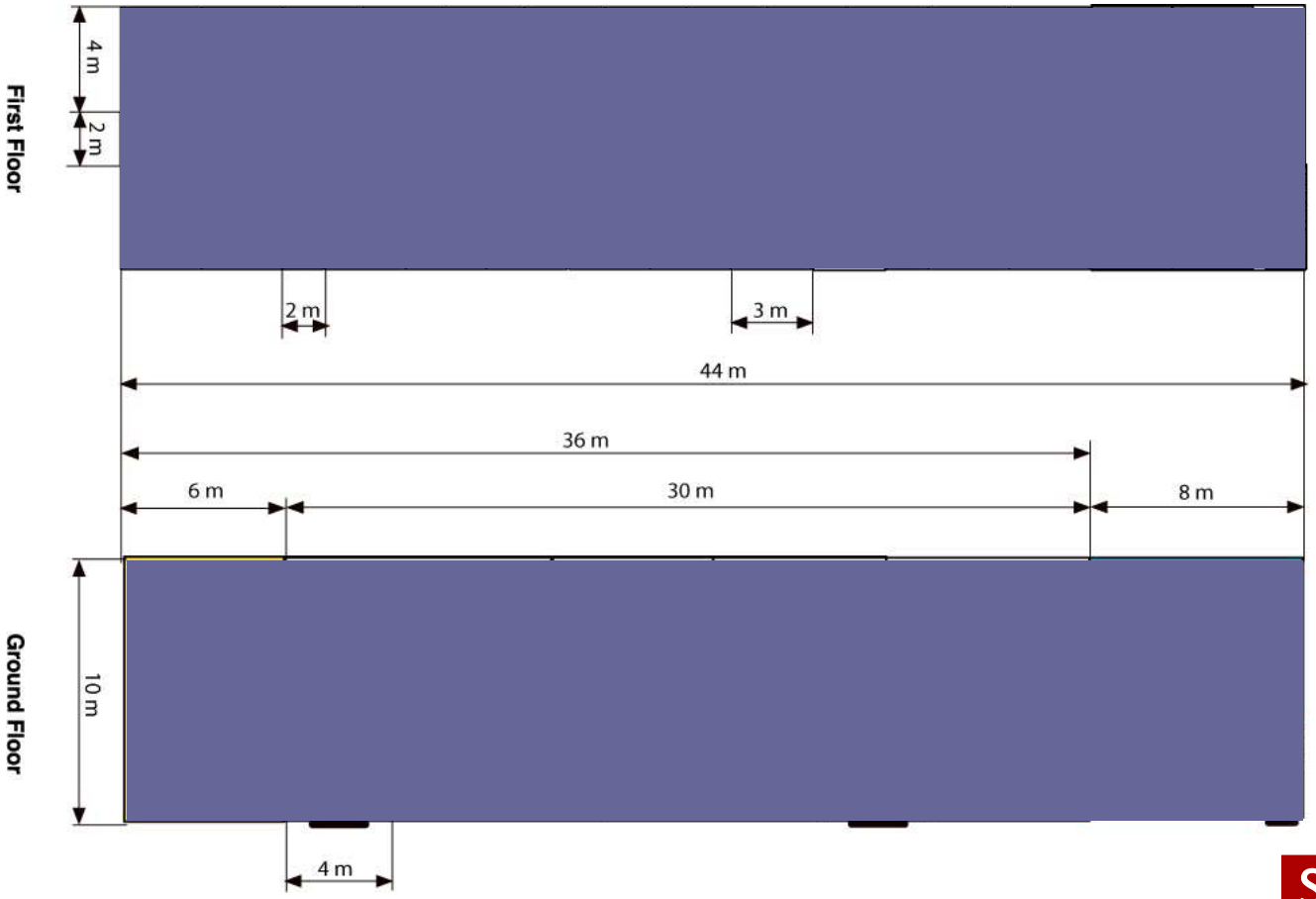




- 2000 m2
- Entrance of site
- Large unloading and storage space (6 tons crane)
- Mechanics and electronics workshops, clean and dark rooms
- Main parking area (2800 m2)

South	North
2,5 M€	2,5 M€

Residence building



- 880 m2
- 40 pers.
- Far enough to avoid disturbance (light)
- Assumes no facilities exist nearby
- 20 persons
- Reception/guard apartment;
- Medical Unit;

South	North
2,1 M€	2,1 M€

Others

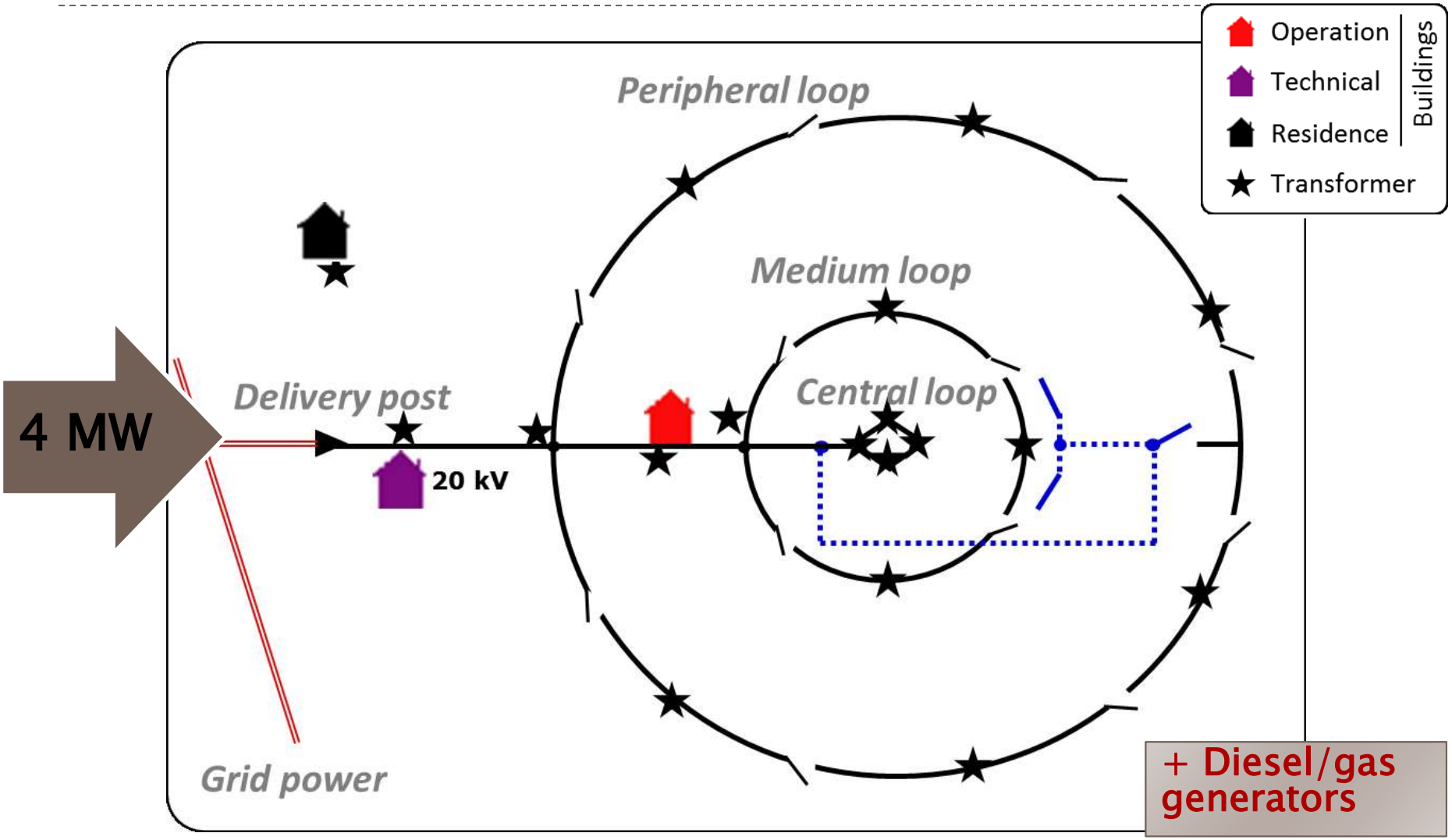
- **Water and sewer system**
  - Buildings : 70 liters /day/person, 40 persons max.
  - Construction : 15 m^3 /day (300 m^3 LST concrete foundations).
- **Fire hydrants**
- **Lightening protection**
- **Communication**
  - Phone to outside & on site

Managing the peak power

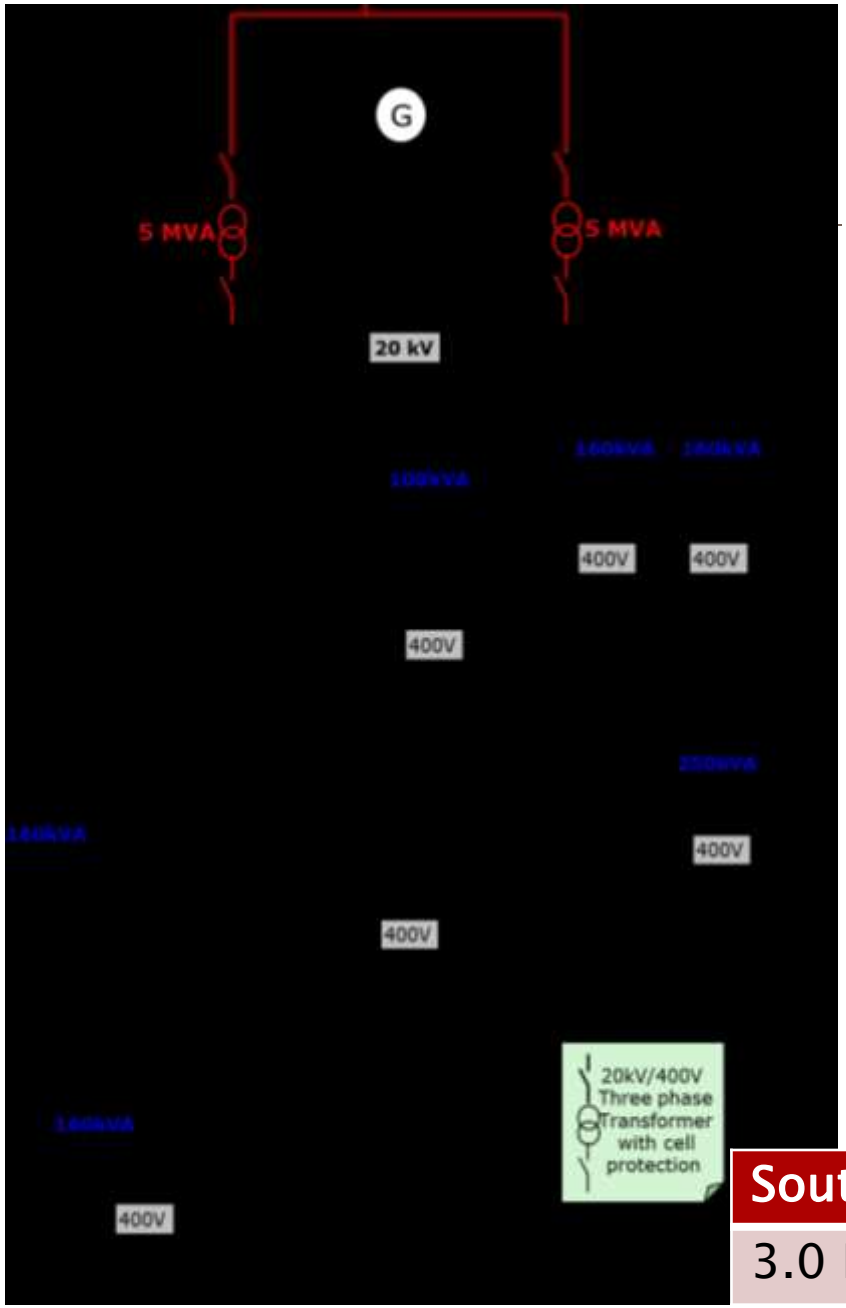
Consumption (kW)	Tracking	Repositioning	Accelerating (5 – 20 s.)
South	1200	2400	3400
North	530	730	1600

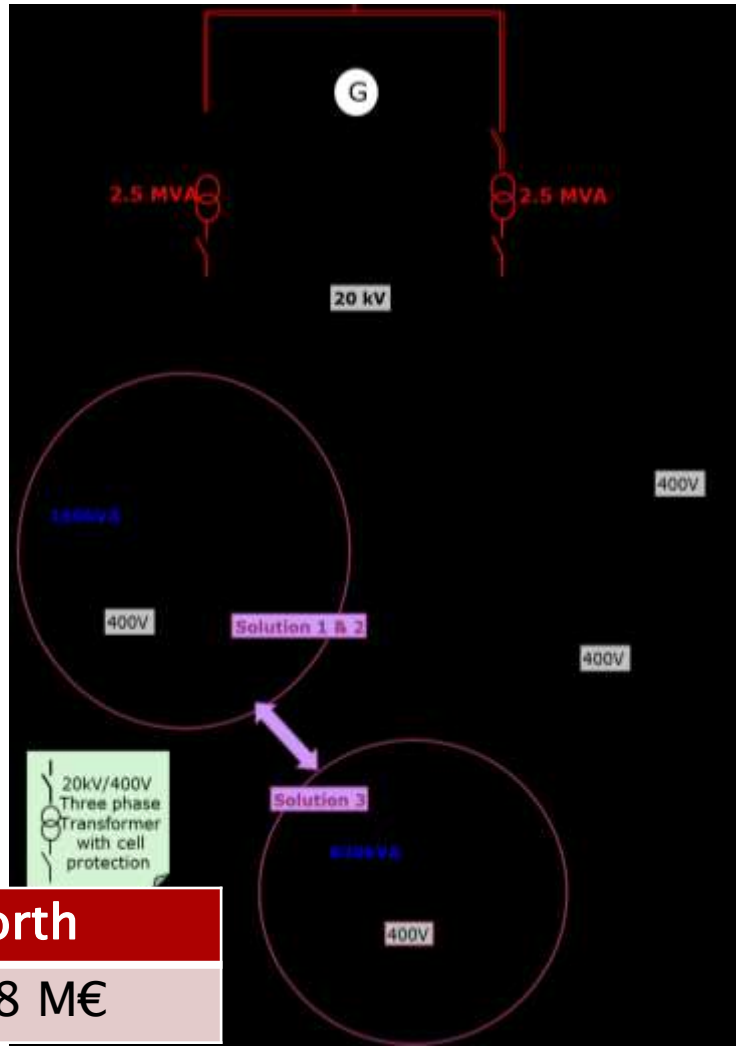
- Includes 300 kW for the buildings
- 2 (resp.1) MW extra power during acceleration
  - transformers accept huge overloads if short →used for optimisation
  - Could be managed by on site energy storage
    - Not considered in this study
- Conclusion 4 (resp. 2) MW required at the site fences for South (resp. North)

Power network architecture (e.g.: South)



Optimised layouts

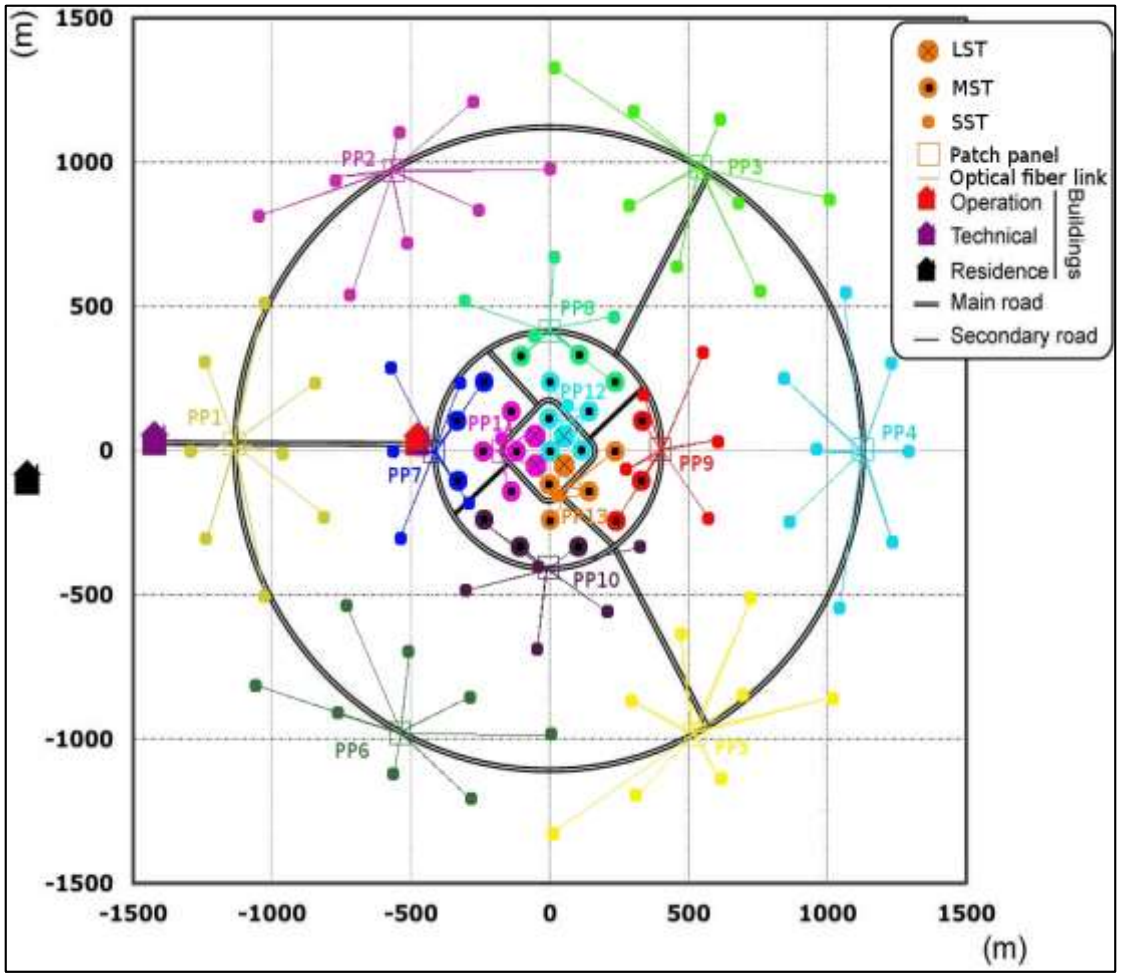




South	North
3.0 M€	0.8 M€

Data Network

From J. Houles – Preliminary



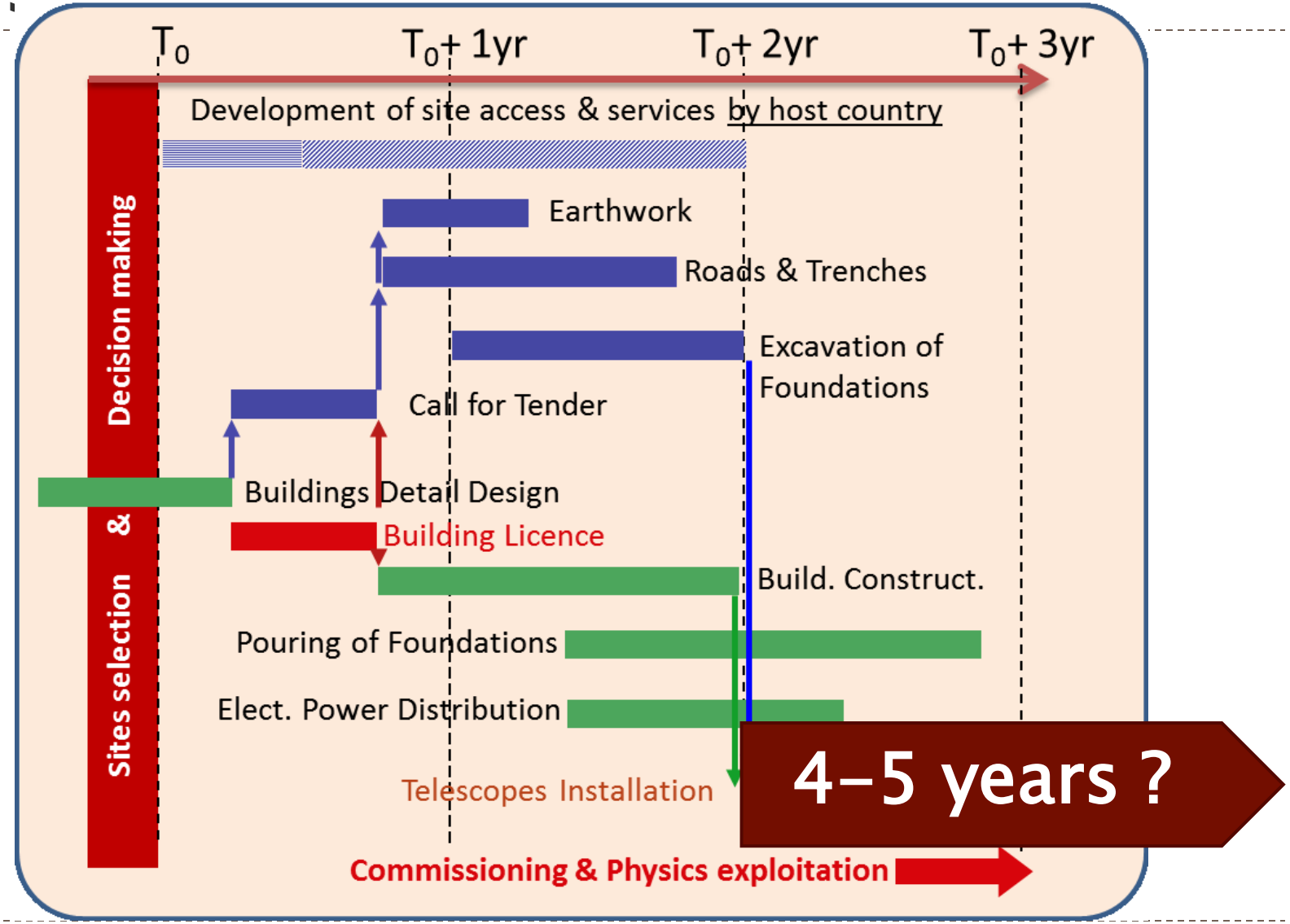
- Estimates from a former study (South without SCT)
- Uses power network trenches
- Includes manpower for cable installation

South	North
0.5–1M€	0.05–0.1M€

Construction costs

Generic site cost estimate	South		North	
Indicative standard EU costs	M€	% ot total	M€	% ot total
Landscaping and site Work	6.2	16%	0.8	5%
Roads & parking, fences, gates	7.8	21%	1.7	12%
Concrete of telescope foundations	4.4	12%	1.3	9%
Electrical power network	3.0	8%	0.8	6%
Data network (approx.)	1.0	3%	0.1	1%
Others from PBS	0.8	2%	0.0	0%
Infrastructure w/o buildings	**23.1**	**61%**	**4.7**	**33%**
Operation builiding	2.0	5%	2.0	14%
Technical building	2.5	7%	2.5	17%
Residence building	2.1	6%	2.1	15%
Buildings	**6.6**	**18%**	**6.6**	**46%**
Total infrastructure	**29.7**	**18%**	**11.3**	**79%**
Site characterisation	0.1	0%	0.1	0%
Project management (10%)	3.0	8%	1.1	8%
Total with 15% contingency	**37.6**	**100%**	**14.3**	**100%**

Project schedule



Conclusion

- **Infrastructure investment cost:**
  South ~ 38 M€, North ~ 15 M€
  - Buildings in North oversized ?
  - Obtained with “typical” 2012 EU-French prices
  - No VAT

- **Not included**
  - Manpower for construction (10 FTE x 5 years ~3 M€)
  - Operation cost (studied elsewhere)
  - Cost for services to the fence
    - Access roads, water, power, internet

Implementation on sites

Phase 2

What need to be evaluated for each site?

- **The cost of the generic infrastructure implementation**
  - Individual components may differ in nature e.g. because of geology/hydrology
- **The costs related to the infrastructure location**
  - Supply and access to services (power grid…)
  - Service reliability
- **Operation/maintenance costs → who ?**
- **The cost for specific risks → see J. Carr's talk**
  - e.g. resistance of telescopes to earthquake, sand storms, winds…
  - economical risks ?

First ideas on site specificities

- **Questionnaire sent on June 6th, 2012 to all sites**
  - Answers received between September and December, 2012
- **Existing infrastructure**
  - 2 MW electrical power : availability, reliability
  - Access road
  - High bandwidth communications cost to site.
- **Legal and formal aspects**
  - Procedure for building licences
  - Local building codes
  - Labour regulations
- **Local costs**
  - Roads, cable ducts, fences, concrete, buildings
  - Fuel, electricity
  - Manpower for various qualification
- **Technical characteristics of the subsoil**

Analysis of the answers – South

Preliminary

- **Chile**
  (Nov. 2012)
  - No power line → generators
    - grid@75–100 km–await ELT ?
  - Roads from Paranal (≈20 km?)
  - Data network @75km
  - No soil study

- **Namibia – Aar**
  (Dec. 2012 – subcontracted)
  - Power : Request sent to *NamPower*
  - Road@ 6km
  - Data Network : quotation from *Telecom Namibia*
  - Soil : Study ordered to *GeoLogic solutions*
- **Namibia – Hess**
  (Dec. 2012)
  - Power : Request sent to *NamPower*
  - Data Network : quotation from *Telecom Namibia*

- **Argentina–S. Antonio d.l. Cobres**
  (30 Aug. 2012)
  - Infrastructure and services provided, includes
    - Power (2 MW) for **free**
    - Access roads + site roads and ducts for **free**
    - Data network for **free**
  - No soil study
- **Argentina – Leoncito**
  (30 Aug. 2012)
  - Infrastructure and services provided, includes
    - 13 kV exists, best distance to grid not mentioned
    - Road@10 km
    - Data Network : 100 km or through grid.
  - No soil study

Analysis of the answers – North

- **Mexico**
  (4 Sept. 2012)
  - Power grid : free for CTA
  - Access road exists*
  - Data network exists*
  - Soil study ready to be ordered (in particular water pocket investig.)

** Minor costs*

- **Spain – Tenerife**
  (25 Sept. 2012)
  - Power : 20kV/5 MW at Izana → connection:280 k€
  - Many answers missing
  - No soil study

- **USA– Yavapai ranch**
  (1st Oct. 2012)
  - 13 kV @20 km
    → quotation : 5 – 12 M$
  - Access road @4km
  - Data Network : 175 Mbps – 1.4 Gbps with monthly costs
  - Soil characteristics given

- **USA – Meteor Crater**
  (1st Oct. 2012)
  - 13 kV @10 km
    → quotation : 3.4 M$
  - Access road @ 1km
  - Data Network : 175 Mbps – 1.4 Gbps with monthly costs
  - Soil characteristics given

THIS TABLE NOT TO BE TAKEN SERIOUSLY !!!

1€ = 1.30 US$ = 11,23 N$ = 5,69 AR$ = 16,54 M$

Analysis of the answers

WARNING : APPROXIMATE NUMBERS USED AS AN ILLUSTRATION OF THE ANSWERS RECEIVED

Country		Argentina	Argentina	Namibia	Namibia	Chile	Mexico	USA	USA	Spain
Location		S. Antonio	Leoncito	Aar	Hess	Armazones	San Pedro	Yavapai Ranch	Meteor Crater	Tenerife
7	Building licence (months)	6	3	Env.imp. study		4	Env.imp. Study	15	15	12
9	Access road (k€)	0	≈ 215 (0)	≈ 1000		≈ 90 €/m x 20 km?	Exists	240	60-120	NA
10	Road inside site (€/m)	0	21.5 (0)	84.6	84.6	90	74.8	60	60	NA
11	Buried ducts (€/m)	0	12.3* (0)	2.7	2.7	42.5	5.75	45-90	45-90	unclear
12	Fences (€/m)	39*	31*	62.3	62.3	17	41.5	45	45	8
14	Concrete cost (€/m3)	600*	635	≈ 150 (nr)	≈ 150 (nr)	550 (nr)/900	120-228 (nr)	130 (nr)	130 (nr)	NA
15	Office cost (€/m2)	790	710	≈ 700	≈ 700	2800	long list	≈1650	≈1650	NA
16	Appartment (€/m2)	670	800	≈ 750	≈ 750	3300	long list	≈ 1450	≈ 1450	NA
17	Technical buildings (€/m2)	335	460	692	692	3600	long list	≈ 1100	≈ 1100	NA
18	Enginneer (k€/yr)	32	32	21-53	21-53	53-76	?	60-100	60-100	100-135
	Technician (k€/yr)	21	21	16-42	16-42	37	?	60	60	83
	Housework (k€/yr)	16	16	> 3.5	> 3.5	20	?	30	30	60
20	Data network/cost	0	≈ 2.6 M€ (or grid) (0)	Quot. @30km	Quot. @90km	10 €/m x ???	575€ ?	Microw @>175Mbs	Microw @>175Mbs	NA

Preliminary conclusions

- **Questions sometimes too vague**
  - e.g. answers on what is a duct differ
- **Answers sometimes cannot be compared**
  - Prices with VAT ?
  - Salaries are charged ?
  - Concrete reinforced or not ?
- **Roads, ducts and foundations depends on precise soil studies**
  - … Which are not always available!
- **Exchange rates and inflation can bias the comparison**
- **Specific costs need to be evaluated**
  - Special landscaping, bridges, reinforcements
  - Extra cost due to the environment
- **Requires a uniform investigation**
  - Ask to a single company to study all sites on a given hemisphere

→ Call for Tender

Call for tender

- **Restricted to civil engineering**
  - roads, foundations, trenches, buildings,
  - Note : Should we ask interfaces to the outside ????
- **Two separate options**
  - South sites
  - North sites
- **Suggest to restrict to the 2x3 high priority sites to speed-up the process**
- **Request an intermediary milestones**
  - Identified difficulties
  - A first estimate of each site costing
- **Ask detailed studies and justifications of the estimated costs from a simplified WBS**
  - Final uncertainties of 15-20%

First contacts with companies

- **Elan France (Bouygues affiliate, http://www.elan-france.com/)**
  - Interested
  - Met on March 5th, 2013, now checking affiliates.
- **Arcadis – (http://www.arcadis-fr.com)**
  - Identified contact
  - interested, are contacting international affiliates
- **Ingerop –(http://www.ingerop.fr/)**
  - Identified contact
  - Confirm they will answer to the call
  - Affiliates are identified for South
    - Ghisolfo in Chile for Chile and Argentina
    - Ingerop International Consultants in Johannesburg for Namibia
  - Meeting on April 11th at the Ingerop headquarter.
- **More companies could be contacted : Egis, Elite, Dumez & Borie**

Phase 2 – Tentative schedule

- **Preparation of the Call for tender data pack**
  - STARTED, deadline < mid April
- **Check by the CEA contract Dpt + Issuing of the Call**
  - < End April
- **Company answer preparation**
  - +5 weeks, deadline June 3rd
- **Analyse of the answers,**
  - + 2 weeks – mid-June
- **Contract finalisation and signature**
  - +2 week – end of June
- **Time to get the studies**
  - +4 months (3+1 month for Summer) ← end of October

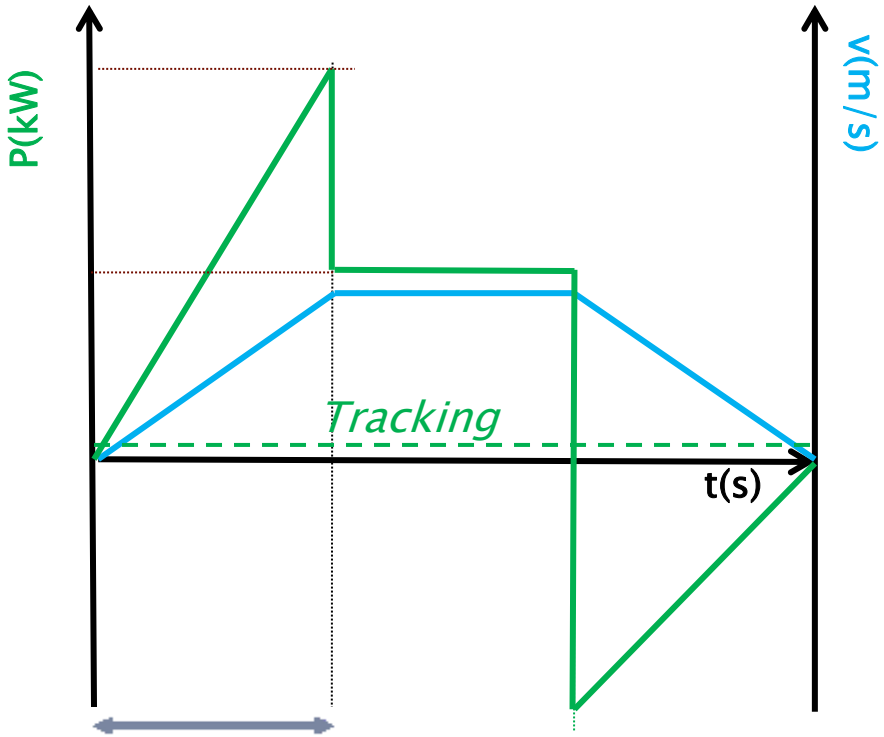
Conclusion

- **Phase 1**
  - General ideas for definition < summer 2012
  - Compilation of telescope characteristics : fall 2012
  - Deep studies of power consumption management : fall 2012
  - Telescope array finalisation (SCT) and infrastructure requirements finalised mid-January 2013
    - Some details still to be fixed/studied
  - Study released March 15th
    - Infrastructure cost is ~38 M€ (~14 M€) in South (North resp.)
- **Phase 2**
  - Requires phase 1 completion
  - Requires investigation /costing
    - local infrastructures – Started June 2012 – to be finalised
    - Operation costs
    - specific risks
  - Call for tender for infrastructure cost departure
    - Started early 2013 (Contact with companies)
    - Final answer by end of October 2013
    - Beyond the present proposed schedule for site selection
      - Intermediate answer early September possible ?
      - Concentrate on Southern site as a first step ?

Backup

Power consumption

Repos.	LST	MST	SCT	SST
Dt(s)	~20	<90	~60	~120



Acceler.	LST	MST	SCT	SST
Dt(s)	6	10	6	20

Drive consumptions

	LST	MST	SCT	SST
Tracking (W)	50	20	20	0.3
Repos. (kW)	10	12	18	2-6
Acceler. (kW)	220	14	26	6-9

Stable
+ Camera
+ Buildings