1.10 Chile Site Infrastructure, Integration and Commissioning Status

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CMB-S4 Collaboration Meeting
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Outline

- Subsystem Team
- Scope
- Changes in the Past Year
- Technical overview/progress/status
- Near-term plans
- Conclusions

Chile Site Infrastructure, I&C Team

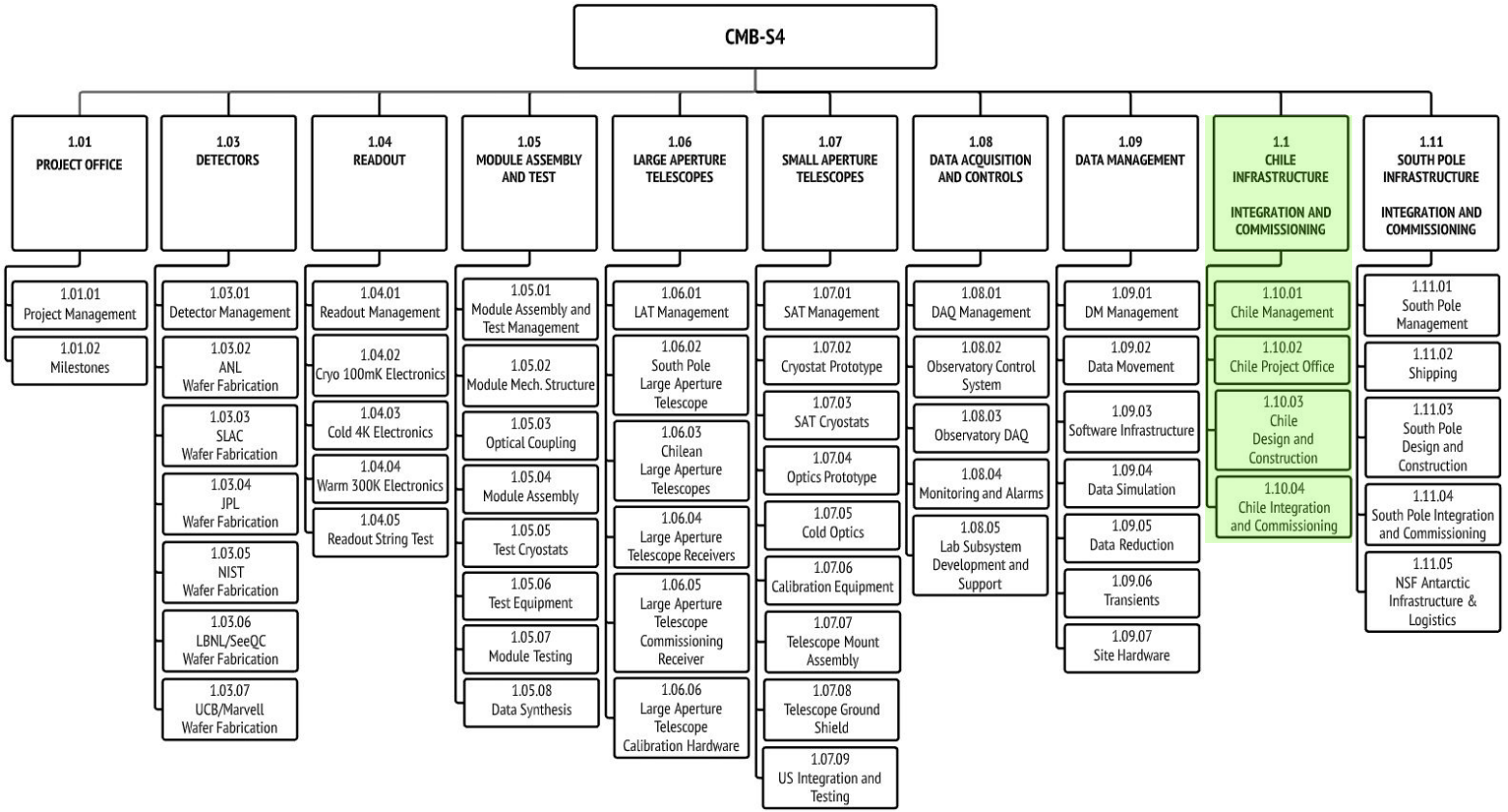
10.01, 10.02, and 10.03: L2 scientist (Arnold) and CAM (Pilleux) have brought their experience with civil construction of ALMA and the design of Simons Observatory to plan 10.03 Chile Design and Construction and 10.02 the project office.

10.02: Roberto Ibánez brought his expertise in environment and safety at ALMA to draft our EH&S documents and run our baseline studies.

10.03: Alberto Montealegre of Montealegre Beach Arquitectos supplied the site master plan with fully costed cut sheets

10.04: Tyler Natoli is also L3 lead for South Pole LAT Integration and Commissioning and is developing both those plans based on his Stage 3 experiment experience.

Chile in the S4 WBS



Scope (WBS Dictionaty to Level 4). No changes due to AoA

Level	WBS#	WBS Title	Sponsor	Summary/Description
2	1.10	Chile Site Infrastructure, I&C		
3	**1.10.01**	**Project Management**	**NSF**	**High-Level management of the Chile project office, based partially in the US**
3	**1.10.02**	**Chile Project Office**	**NSF**	**Local management of all Chile activities: regulatory compliance, human resources, vendor contracts, procurements, interfacing with the Chilean government.**
4	1.10.02.01	Chilean Agreements	NSF	Manage Chile agreements with key stakeholders
4	1.10.02.02	Project Payments	NSF	Perform agreed payments to key stakeholders in Chile
4	1.10.02.03	Site Maintenance	NSF	Manage the operation and maintenance of the Chile sites
4	1.10.02.04	Procedural Documents	NSF	Establish the environment, health & safety policies and procedures of the Chile activities
4	1.10.02.05	Site Equipment	NSF	Procure and maintain all equipment required by the Chile Project Office to perform its duties
4	1.10.02.06	Human Resources	NSF	Perform the human resources management activities required in Chile
4	1.10.02.07	Santiago Office Outfitting	NSF	Rent, outfit and maintain an office in Santiago to perform the main Chile business activities
3	**1.10.03**	**Chile Design and Construction**	**NSF**	**Perform all design and construction activities of the Chile infrastructure**
4	1.10.03.01	Civil	NSF	Design and build all Chile civil infrastructure
4	1.10.03.02	Power Generation & Distribution	NSF	Design and build all Chile power generation infrastructure
4	1.10.03.03	Data/Communications	NSF	Design and build all Chile data/communications infrastructure
4	1.10.03.04	Site Monitoring	NSF	Design and build all Chile site monitoring infrastructure
4	1.10.03.05	Cooling System	NSF	Design and build all Chile cooling system infrastructure
3	**1.10.04**	**LAT Integration and Commissioning**	**DOE/NSF**	**Perform integration and commissioning of the LATs**
4	1.10.04.01	I&C Requirements Definition	NSF	Establish all requirements for the Chile instrument
4	1.10.04.02	Major Equipment Imported to Chile	NSF	Import all equipment to Chile
4	1.10.04.03	I&C Implementation	DOE/NSF	Integrate the receivers and commission the Chile LATs

Business office in Santiago, Construction management team, and management of low-elevation facility in or near San Pedro de Atacama

Design activities by vendors (Chile and international), construction and installation activities on-site at the HEF

I&C planning is based on project requirements.

Changes since last year

- No changes based on the analysis of alternatives
- We conducted a trade study for power generation including diesel, diesel-photovoltaic hybrid, and piped natural gas. We are finalizing that trade study now for submission to project management to re-baseline with a hybrid diesel-photovoltaic system

Chile Site Location: Overview

Site on Cerro Toco is 55 minutes by 4WD truck from the logistics base (low-elevation facility) in San Pedro de Atacama, and 15 minutes from the ALMA Array (high site)

The Chile High Elevation Site

- This site has been home to leading CMB instruments for almost 3 decades.
- Current experiments include: Advanced ACT, POLARBEAR/Simons Array, and CLASS
- Simons Observatory is currently under construction on this site: foundations poured, SAT platforms (bases) installed, LAT being installed now
- The CMB-S4 Infrastructure design is based on experience with these experiments and the nearby ALMA Observatory

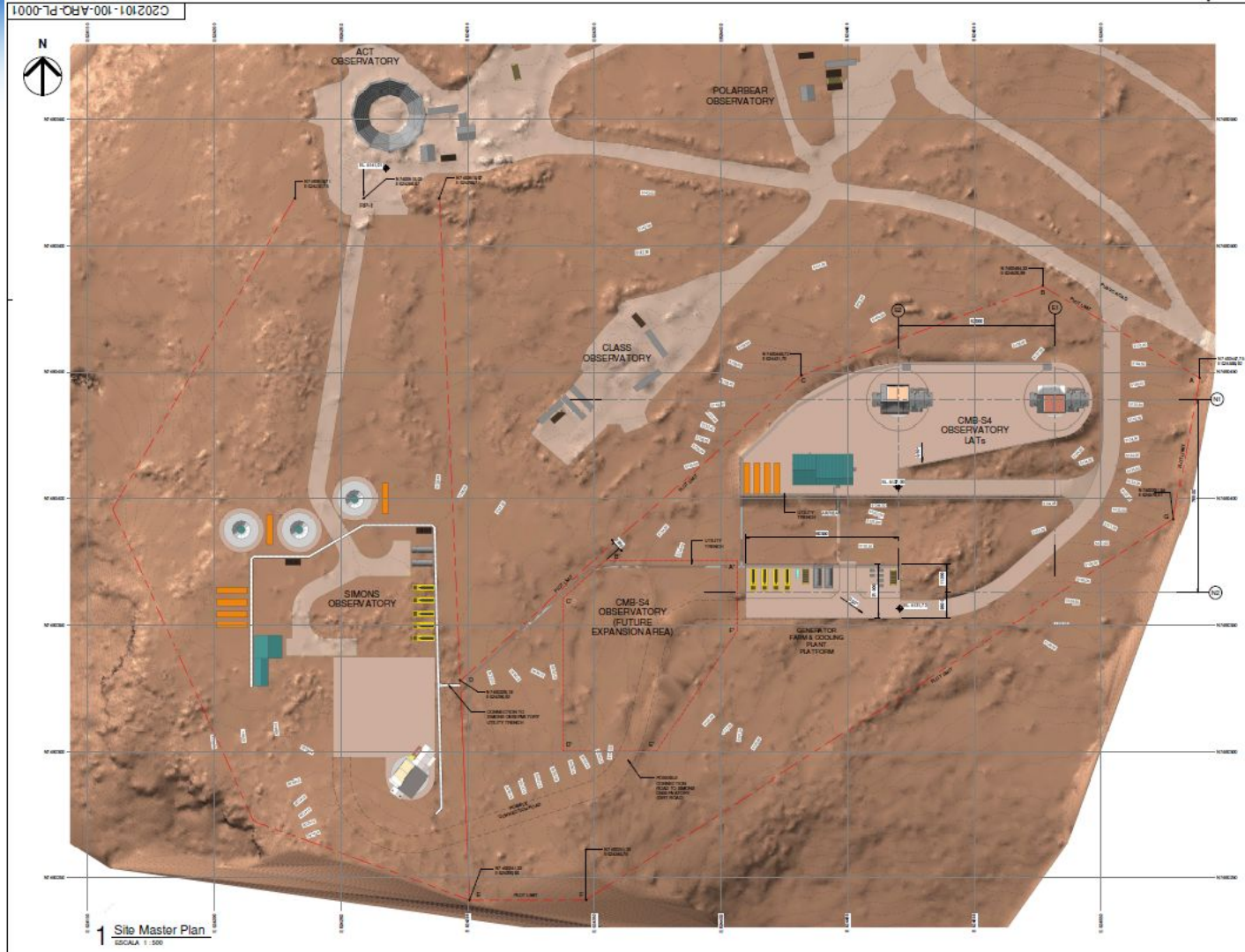
Leveraging Experience:

- L2 Lead for 1.10 is also the L2 lead for the Simons Observatory Site Infrastructure Work Package, and has been working at this site for 11 years.
- L2 Control Account Manager for 1.10 was deputy project manager of ALMA for NRAO during ALMA Construction and Chile Business Manager (12 years)
- Detailed designs and cost information are being shared

Chile Site Driving Requirements

- **Observing Efficiency:** preparing for robust operation of the site to ensure maximum uptime. Puts requirements on power generation, access infrastructure, remote monitoring, etc.
- **Utility requirements:** Electrical power, cooling, internet access, compressed air. Requirements are well-developed enough for conceptual design now, and can be
- **Foundation Requirements:** LAT foundation design based on observing and survival loads under specified environmental and seismic conditions
- **Optical Interference Requirements:** set the spacing between LATs and all other infrastructure on the site
- **Integration and Commissioning Requirements:** Space for assembly of all items, support for the number of people needed on-site which is the highest population expected on-site, and infrastructure to support all I&C equipment.

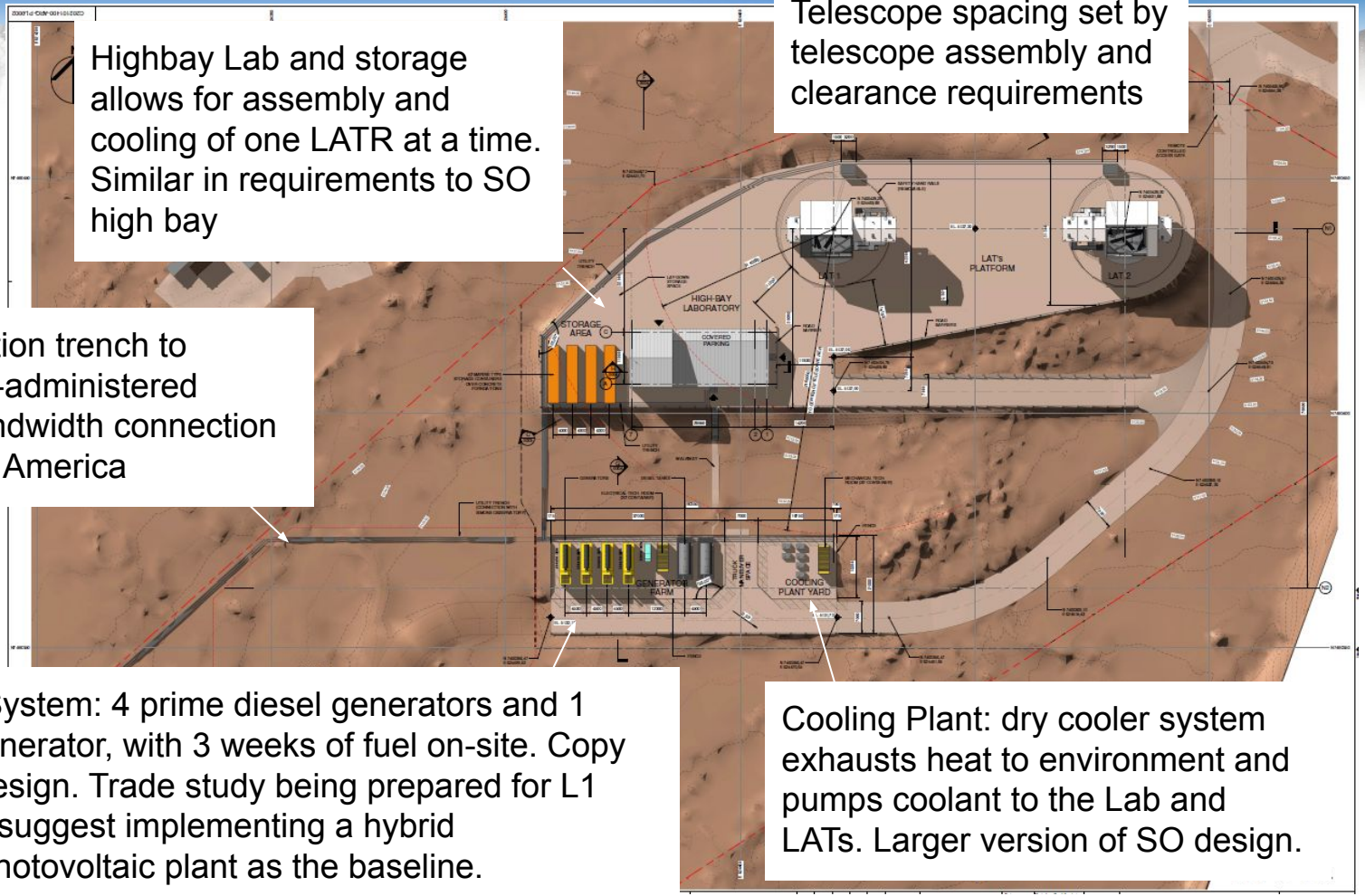
Site Layout (1)



Highbay Lab and storage allows for assembly and cooling of one LATR at a time. Similar in requirements to SO high bay

Telescope spacing set by telescope assembly and clearance requirements

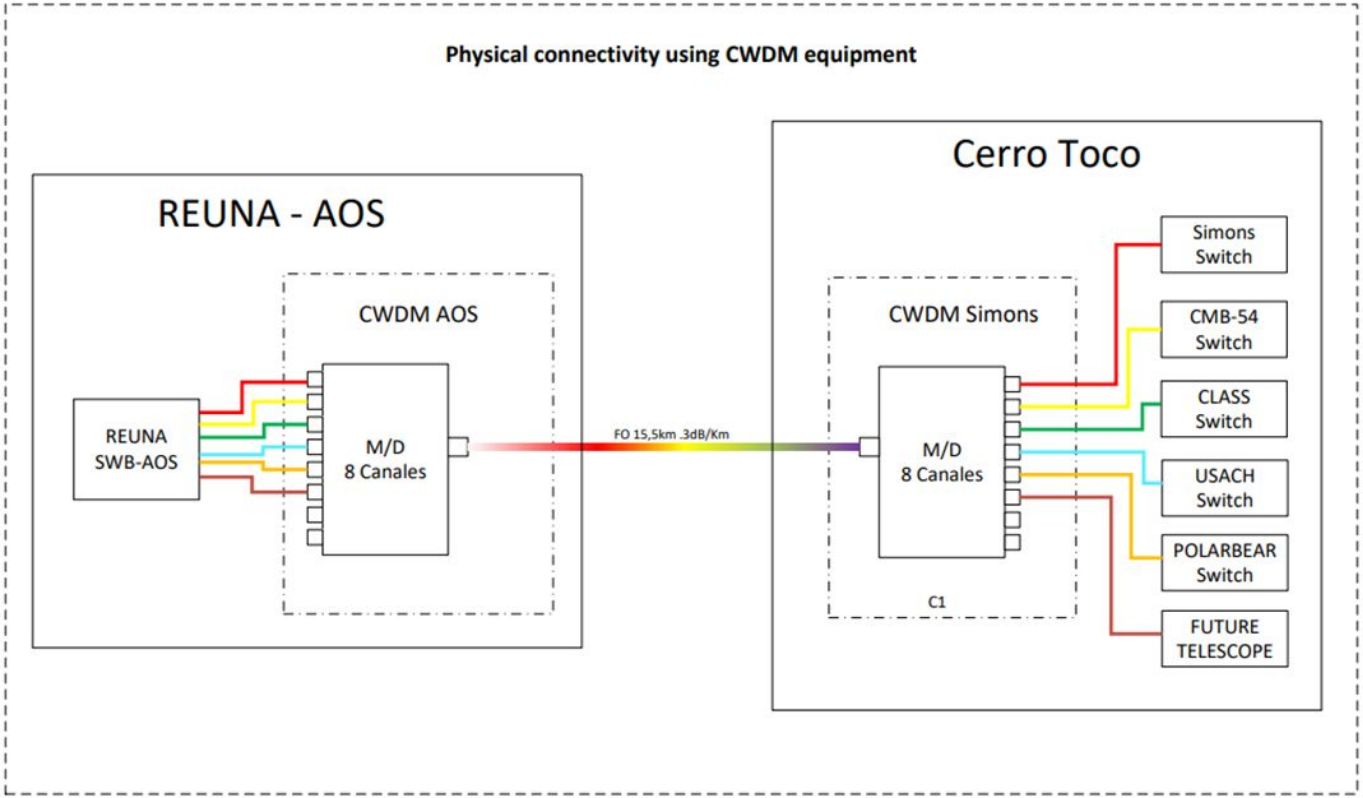
Connection trench to REUNA-administered high-bandwidth connection to North America



Power System: 4 prime diesel generators and 1 utility generator, with 3 weeks of fuel on-site. Copy of SO design. Trade study being prepared for L1 that will suggest implementing a hybrid diesel-photovoltaic plant as the baseline.

Cooling Plant: dry cooler system exhausts heat to environment and pumps coolant to the Lab and LATs. Larger version of SO design.

Shared fiber link to the outside world



CWDM passive multiplexer will be at Cerro Toco and made available by the Parque to all instruments.

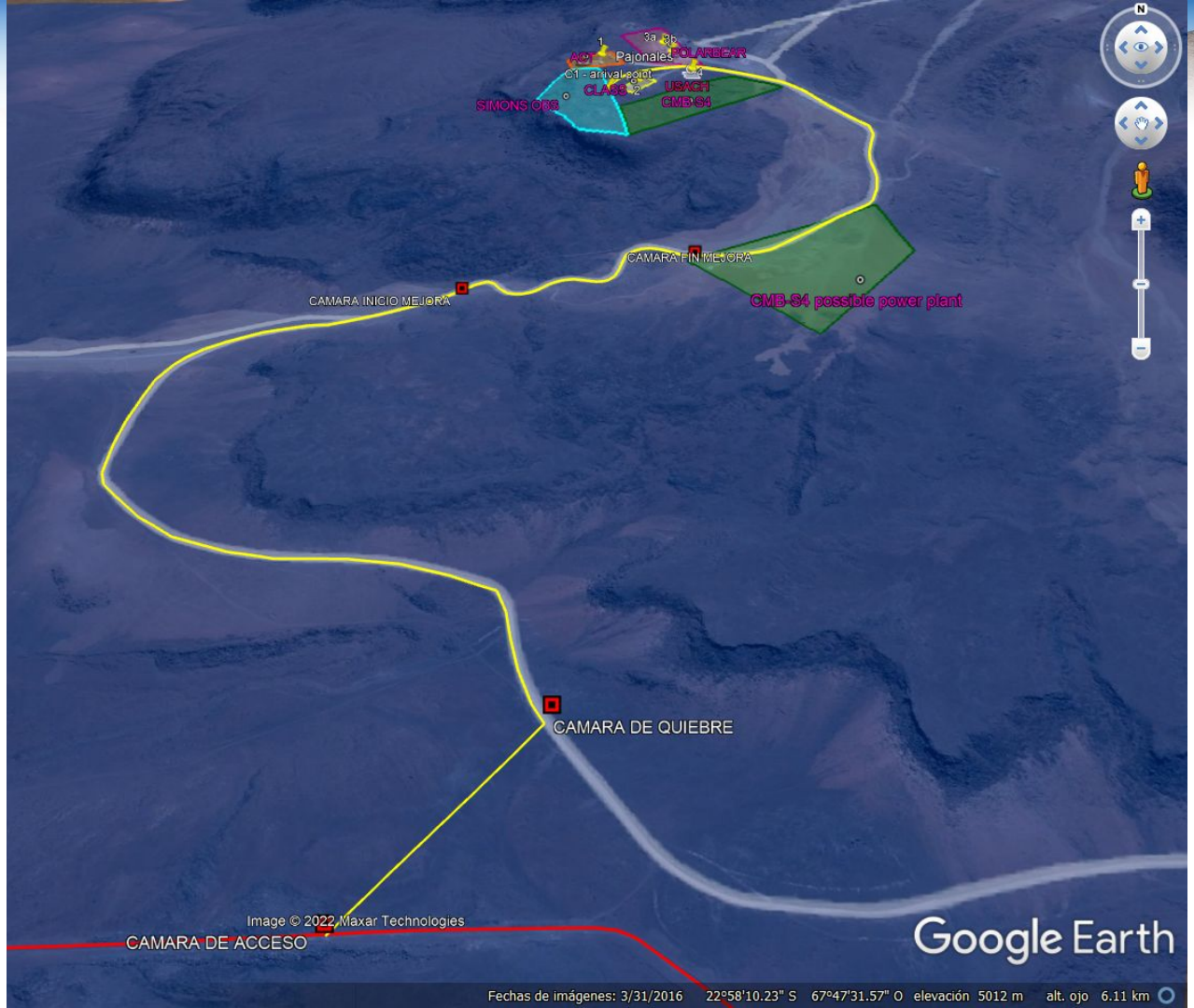
Silica is currently getting bids from contractors for the trenching for the fiber.

The implementation of this will probably be that the CWDM is physically in a rack in an SO structure, and SO has an agreement with the Parque to provide this hosting service.

SO and S4 could have fully separate or a single agreement with REUNA

Hardware to support up to 10 Gbps capability is deployable now, bandwidth could be higher later

Silica FO layout

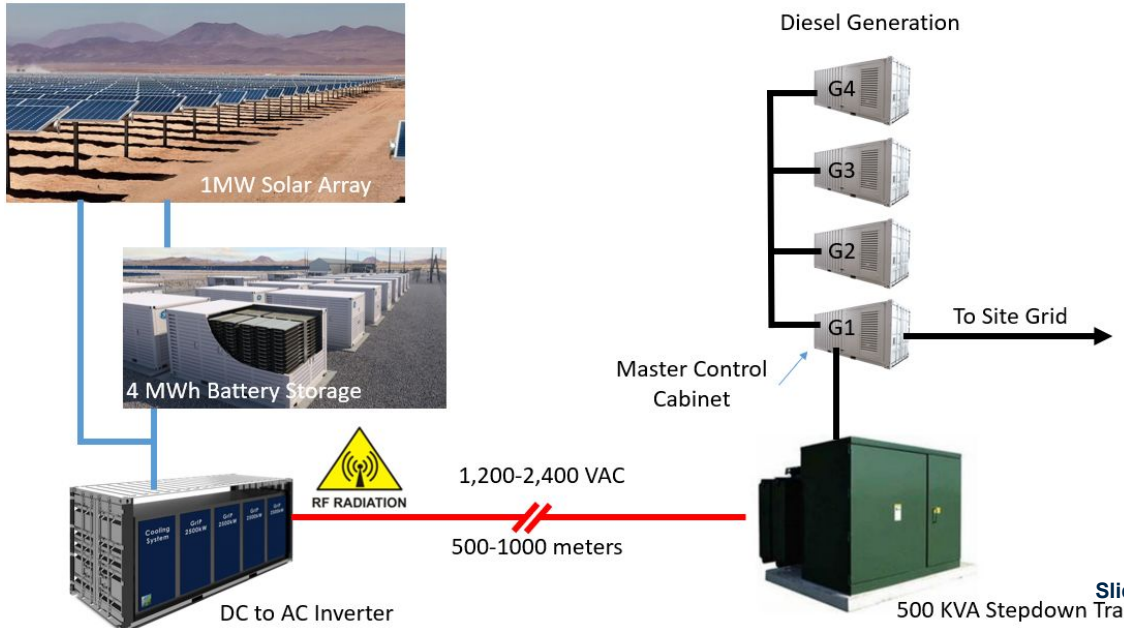


Photovoltaic Array (PVA)

- PVA increases power reliability and reduces risk due to diesel truck deliveries via road:
  - 100% diesel would means 1M liters/year - delivery every other day (5000 liter trucks)
- PVA reduces overall life cycle cost through reduced generation costs:
  - Full Diesel: 0.40 $/kWh
  - PV/Diesel: 0.07 $/kWh

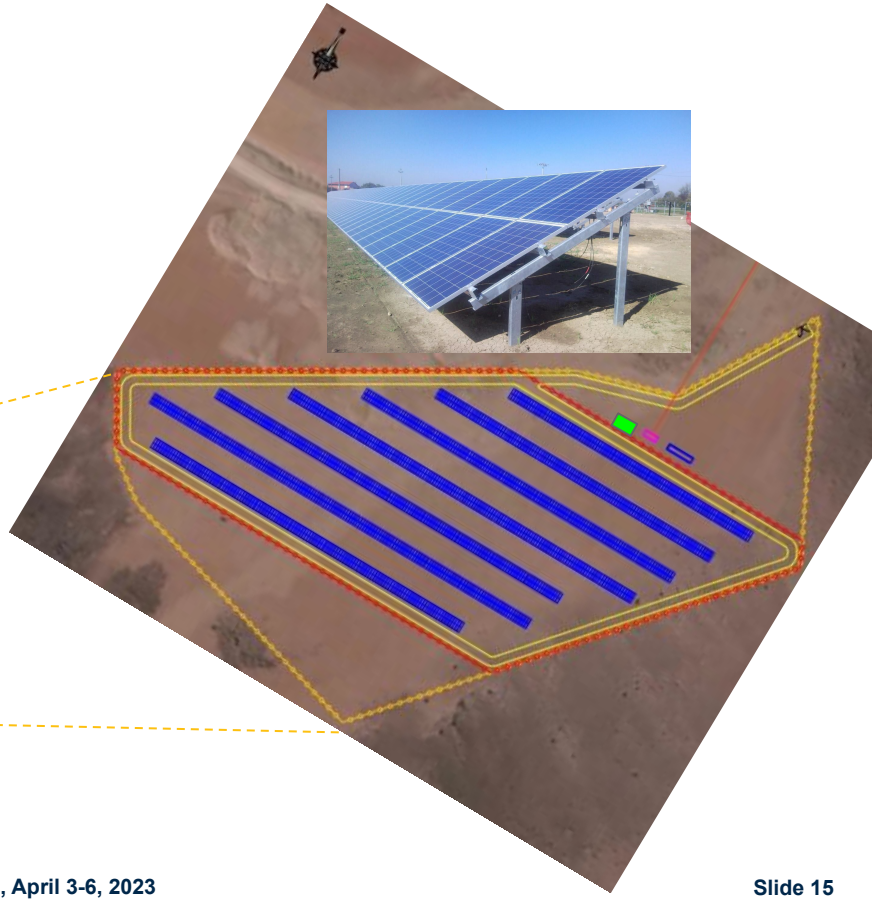
Concept: micro grid architecture
Multiple vendors responded to a request for conceptual proposals

Will be implemented as an extension of the SO array (if awarded to SO) or stand-alone, SO funding will be known within this FY (FY23)

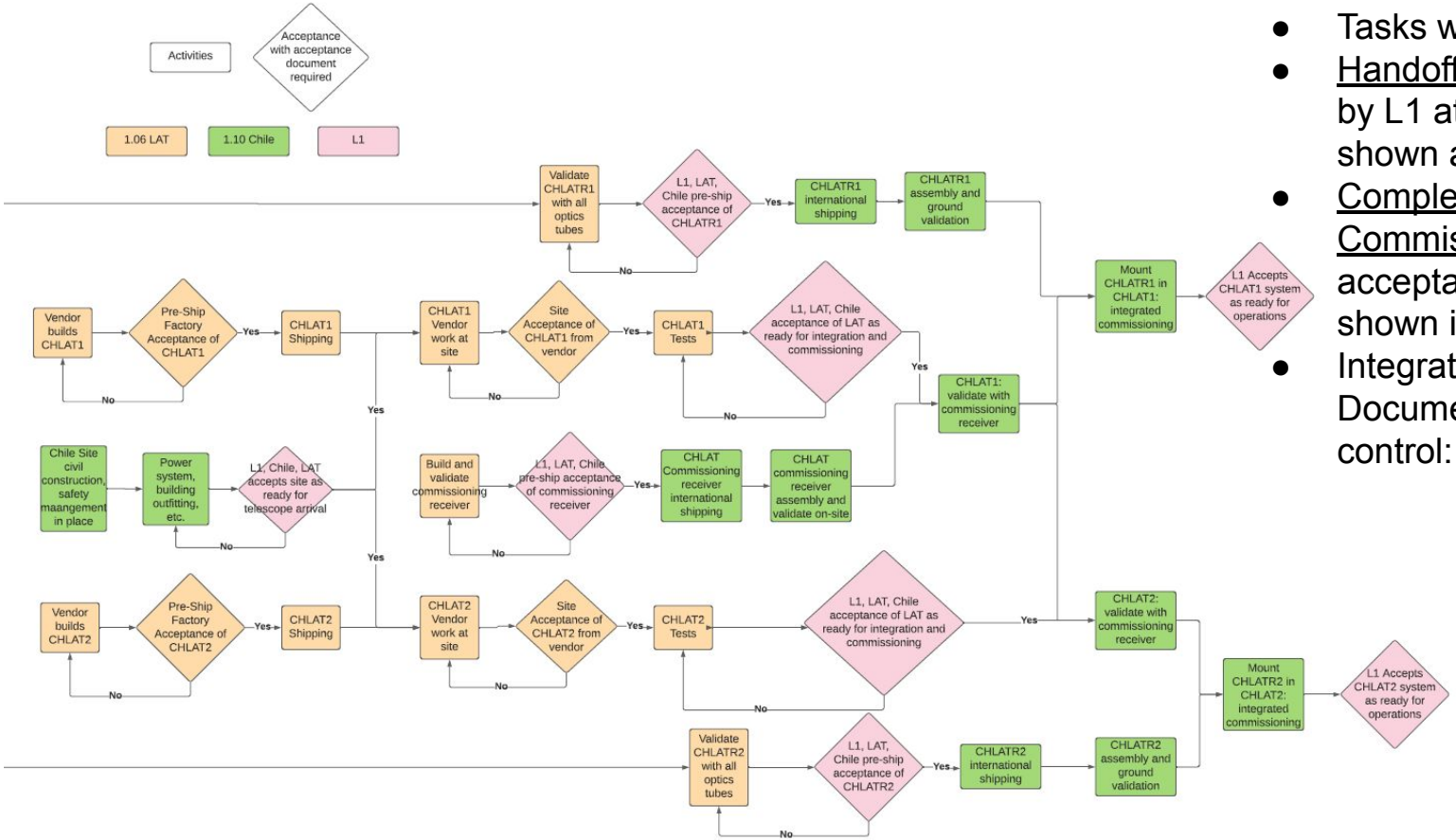


SO & S4 Power Requirements

- SO = 340 kW
- S4 = 314 kW



S4 Chile L2 Scope: Integration & Commissioning



- Tasks within this L2 in **green**
- Handoff with LAT mediated by L1 at acceptance points shown as pink diamonds
- Completion of Integration & Commissioning at project acceptance by L1, also shown in pink diamonds
- Integration & Test Plan Document through change control: doc-730

System Design Maturity

- **10.02 Project Office**
  - Legal, regulatory, safety issues well understood based on previous observatory experience from nearby CMB experiments and large projects like ALMA, GMT, etc.

- **10.03 Chile Design & Construction**
  - Requirements understood well enough to scope out system in all areas
  - Baseline power generation system based on existing diesel systems. PVA system design based on proposals from vendors with experience and will be coordinated with the SO process this year if the SO PVA plant is funded.
  - Telescope foundations based on existing design for this telescope design, which is the same as that for Simons Observatory
  - Highbay, earthworks, and site master plan all created and costed by an architect
  - High-Bandwidth connection to site being built now let by the Atacama Astronomical Park (land administrator)

- **10.04 Chile Integration & Commissioning**
  - Current planning based on experience with previous experiments

Chile Site - Next Steps

- Submit Trade Study of Power System and work with management to re-baseline
- Review and sign-off of all preliminary design documents, including ICDs (with other L2s) to the level that allow final site design, Risks, and Requirements.
  - ICD Review completion set for the end of FY23 to allow final design of the Chilean Site to complete in FY24, **work with other L2s needed to converge this**.
- Monitor progress of Silica Networks fiber implementation that will enable high-bandwidth communication
- Maintain momentum on the political and bureaucratic tasks associated with establishing the University of Chicago as an international entity in Chile
- Produce English translations of relevant applicable Chilean regulations for reference
- Coordinate design safety requirements with Integrated Safety Management Plan and LAT design requirements documentation
- Establish updated basis-of-estimates for costs, and update schedule

Conclusions

- The Chile Site design benefits from the long technical history of smaller CMB experiments at the same site, and the large-scale management experience of larger astronomical projects in Chile such as ALMA and GMT.
  The team is leveraging this experience.

- Designs that will meet requirements are well-developed. In almost all cases they are based on existing systems or existing designs for systems that are currently being deployed as part of the Simons Observatory.