

# Integration and Commissioning WBS 1.09

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September 8, 2018  
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# Integration and Commissioning:

Started with development of cost details for South Pole, still need to include Chile

**Assumptions:** Construction is covered under Sites. Construction “starts” after CD-1 (and CD-3A) in 2021 – Ice Pads, buildings, telescope mounts etc.

Integration and Commissioning starts in Nov. 2024 with Deployment of SA cryostats, LA cryostat deployment in 2025

South Pole Austral Summer typically 3.5 months (assume 20 “work” day/month, 8 “work” hours/day)

SA Cryostats are 3 shooters (3 optics tubes per cryostat) \*\* Kam’s Power Assumed 6? \*\*

3 SA Cryostats at Pole

1 LA Cryostat at Pole, contains 19 optics tubes

# CMBs4-1.09.02.03 SA Cryostat Deployment

## CMBs4-1.09.02.03.01 SA Cryostat 1 (contains 3 optics tubes)

Cryostat 1 Assembly

On-Ground characterization of SA cryostat 1

Install cryostat 1 on telescope

On-Sky characterization of SA cryostat 1

Assumed this takes 3 (out of 3.5) months = 60 days

Assumed 15 days for each of 4 tasks

# CMBs4-1.09.02.03 SA Cryostat Deployment

CMBs4-1.09.02.03.02 SA **Cryostat 2** (contains 3 optics tubes)

Cryostat 2 Assembly

On-Ground characterization of SA cryostat 2

Install cryostat 2 on telescope

On-Sky characterization of SA cryostat 2

# CMBs4-1.09.02.03 SA Cryostat Deployment

CMBs4-1.09.02.03.03 SA **Cryostat 3** (contains 3 optics tubes)

Cryostat 3 Assembly

On-Ground characterization of SA cryostat 3

Install cryostat 3 on telescope

On-Sky characterization of SA cryostat 3

# CMBs4-1.09.02.04 SA Operations and Maintenance

CMBs4-1.09.02.04 Operations and Maintenance in 2025 (concurrent w LA deployment)

Observing with cryostat 1

Observing with cryostat 2

Observing with cryostat 3

Observing with SA in Y4 Winter-over

SA maintenance in Y5

# CMBs4-1.09.02.05 LA Cryostat Deployment

CMBs4-1.09.02.05.01 LA Cryostat 1 (contains optics tubes)

LA Cryostat Assembly

On-Ground characterization of LA cryostat

Install LA cryostat on telescope

On-Sky characterization of LA cryostat

LA Observing (starts in 2025)

# Key Interfaces

- Telescopes and Site development
- Cryostat integration and testing (prior to delivery to sites)
- DAQ : Will Controls be fully tested prior to Cryostat deployment?
- Data management: how much on site storage? Data quality monitoring, data transfer rates
- .... Much more

With Science Team(s)

- Commissioning plan, observing plans



# Cost Summary: 1.09.02.01 Integration and Commissioning Management

Management Coordination: 1 FTE year (1800 hours) for each: Scientist, Postdoc, Mechanical Engineer, Electrical Engineer.

Reviews: ½ FTE Year each: Scientist, Mechanical Engineer, Electrical Engineer

Effort would be spread over a few years but concentrated in 2024 and 2025

Missing: Travel

CMBs4-1.09.02.01 Integration and Commissioning Management - South Pole	\$1,146,960.00
Management	\$894,240.00
Reviews	\$252,720.00

# Cost assumptions: Only Pole, Only People (no equipment or travel included yet)

2024, 2025: SA and LA cryostat deployment teams = 27 People for 3 months (20 workdays/month) :

- Optics tube assembly team 5 (2 scientists, 1 student, 2 postdocs)
- Cryostat team 12 (3 each: scientists, students, postdocs, mechanical engineers)
- Detector/focal plane team 5 (2 scientists, 1 student, 2 postdocs)
- Electronics team 3 (1 scientists, 1 postdoc, 1 electrical engineer)
- Telescope computing data storage team 2 (1 scientists, 1 postdoc)

2024-2025 SA Winter Overs: 3 people (technicians) for 9 months working 7 days/week  
2025:

SA maintenance: 27 for 3 months (9 scientists, 5 students, 9 postdocs, 3 ME, 1 EE )

LA Deployment: 27 people for 3 months

2025 -2026 Winter Overs: 4 for 9 months working 7 days/week

Assumed All equipment is provided with delivery of Cryostats, telescopes etc.

Travel estimate is missing

# Cost Summary: SA, LA cryostat Deployment

Each of 3 SA and 1 LA cryostats assumed same size team (27 people) for 3 months

For SA work will be interleaved on 3 cryostats

CMBs4-1.09.02.03.01 SA Cryostat 1 Deployment	\$1,328,486.40
SA Cryostat 1 Assembly	\$332,121.60
On-Ground characterization of SA cryostat 1	\$332,121.60
Install cyrostat 1 on telescope	\$332,121.60
On-Sky characterization of SA cystostat 1	\$332,121.60

# Cost Summary: 1.09.02.04 SA Ops and SA Maintenance

Total assumes 2 winter overs and same size team (27 people) for 3 months

CMBs4-1.09.02.04 Operations and Maintenance - South Pole	\$1,589,760.00
Observing with SA cryostats (winter-overs)	\$261,273.60
SA maintenance in 2025-2026	\$1,328,486.40

# WBS Cost Summary

CMBs4-1.09.02 Integration and Commissing - South Pole	\$5,916,240.00
CMBs4-1.09.02.01 Integration and Commissioning Management - South Pole	\$1,146,960.00
CMBs4-1.09.02.03 SA Cryostat Deployment - South Pole	\$1,328,486.40
CMBs4-1.09.02.04 SA Operations and Maintenance - South Pole	\$1,589,760.00
CMBs4-1.09.02.05 LA Cryostat Deployment - South Pole	\$1,851,033.60

Still is only a first pass – need to review and adjust, this is more effort than what we assumed in the CDT report

# Issues to be resolved

Review initial ideas with broader group and in context (Today?)

Include Chile

Pole: M&S and travel (how much equipment is provided by subsystems?)

Reconcile Number of pulse tubes and optics tubes on SAT

How much testing will be done prior to shipping? Can we assume that each cryostat has been fully assembled and tested at least once before shipping?

When does the Project End and Operations begin?

# FTE assumptions

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Travel estimate is missing

# CDT Cost assumptions

- CDT – total 28 FTE years
  - Integration SP+Chile : 10 FTE years
  - Commissioning: 18 FTE years
- Comparison to this exercise: 27 FTE yr in this estimate (for Pole alone!) not counting winter over (should they be on operations?).