

Chile/South Pole Sites Infrastructure & Commissioning

Report back Chat questions:

DP: Does that mean SP computing need to be constrained to 120V?

BB: Its all 60Hz at Pole, but electricians can install anything, e.g., all our compressors run on 60 Hz, 220 V, 60 Amp circuits

AS: South Pole is 240 V split phase, just like normal US house power. A 240 V 60 Hz power receptacle can be specified wherever needed.

MS: question to Kam: Chile is a high risk country for earthquake: are we taking this into account for the site construction-facilities ect etc?

KA: On earthquakes: yes, seismic loads drive the requirements for the LAT foundation. Chile has a very robust civil engineering documentation and analysis of risk, and then we base the design on reducing probability of a destruction event to a low enough level.

Parallel Agenda:

Chile Site (30m)

- Site Layout
- Power investigation

South Pole Site (30 min)

- Site layout (Amy) (10 min)
- SAT tower/Blue buildings (Erik N) (10 min)
- SPLAT High bay (Nick E) (10 min)

LAT SAT Calibration Hardware requirements/strategy (10 +5 min) (Kirit & Johanna)

Commissioning Targets (including both LAT & LAT-CR activities): (10+5 min) (John R.)

Notes on discussion during initial plenary session (Kam assigned as initial note-taker, Amy while Kam is talking):

Amy's Plenary:

- Grant asks if transport by ship and traverse is possible. Erik answers that there has only been a proof of concept for cargo on traverse, they don't yet have assurances from NSF that it will be possible.
- Bobby notes that we need to crisp up the definition of completion of the project. It's a scope and schedule driver.

Kam's Plenary:

- Sigurd asks: How easy is it to get snow off large solar panel arrays like this? Would one use power from the diesel generator to melt it so that manual wiping can be avoided? Darcy answers: Snow does not last long at the site and sublimates away pretty quickly
- Patricio asks: How much power will the PVs generate? Kam answers 55days = 2MW peak, 8.8MWH of power.
- Nicholas asks about using ALMA power? Sigurd answers: Linking to ALMA power is the obvious solution. If ACT could have done that we could have avoided a lot of downtime. But I think ALMA hasn't been receptive. Stephen answers: Current ALMA leadership is not interested in becoming a utility company. We (CCAT) tried to pursue this.
- Brenna: Don't have a phased switch over to operations? Why?
 - Happy to be told to do otherwise. This is where the discussion landed as most-straightforward way to state and contain the scope of the project. Jeff Z. Driven by schedule, if the two LATs are separated by more than a year, phased operations could make sense. If they are happening in the same year, then could make sense (but is complicated for NSF).
- Grant points out: There's more than just matching voltage and frequency. There is also load matching. I think with SO there is some penalty with not running our generators at full capacity
- Sigurd: Having something aside from diesel to rely on sounds good. Diesel generator failure was a problem both for QUIET and ACT. Surprisingly many things can go wrong, e.g. the diesel delivery was missing the antifrost stuff at least once in QUIET, causing it to solidify inside the generator
- Darcy: Have you ruled out other power options (ALMA, natural gas)? ALMA is absolutely ruled out. Significant difficulties for local visibility of wind turbines. Past studies have suggested it was hard to converge. Land administrator thinks difficult. Not looked at natural gas piping. Significantly difficulty from regulatory front, but avoids diesel delivery options. Grant: Solar? Yes, that is the one I already talked about as an option.
- Paul Grimes points out: The period when CBI-2/QUIET was first having issues with the diesel being winterized properly was a time when the fuel supply chain to Chile was changing around a fair amount. That project was pretty small at the time and the Chajnantor area was only very sparsely occupied. I'd guess that wouldn't be such a risk now that there are far more and larger astronomy projects in the area, with a lot more local experience and knowledge.

Downloaded chat (pacific time):

- 10:27:14 From Grant Teply to Everyone : Is transport by ship+traverse tractor still viable?
- 10:28:22 From Erik Nichols to Everyone : There has only been a proof of concept for cargo on traverse. We don't yet have assurances from NSF for large-scale cargo movements via traverse.

- 10:32:39 From Eric Linder to Everyone : why are the Chile slides on Indico open (as all other slides are) but the South Pole slides private?
- 10:35:01 From Tom Crawford (he/him) to Everyone : I was able to open those slides without a problem. Do we need to be logged into indico to open them? (I could see that being a reasonable requirement.)
- 10:35:20 From Julian Borrill (he/him) to Everyone : No
- 10:36:29 From Julian Borrill (he/him) to Everyone : At least not generally - a few of the pdfs, including Amy's, have red outlines which presumably means something.
- 10:36:38 From Tyler Natoli to Everyone : The SPSITE slides are labeled as 'Protected' for me and underlined in red. But I can still open them fine.
- 10:37:38 From Julian Borrill (he/him) to Everyone : Fixed now
- 10:38:10 From Eric Linder to Everyone : thanks very much Julian.
- 10:38:30 From Sigurd Naess to Everyone : Where can I see the S4 planned sky coverage?
- 10:39:51 From Julian Borrill (he/him) to Everyone : @sigurd in John Ruhl's presentation from Tuesday
- 10:39:51 From Sigurd Naess to Everyone : (not a question for the speaker, just curious in general)
- 10:40:16 From Sigurd Naess to Everyone : @Julian Thanks
- 10:41:46 From Sigurd Naess to Everyone : @Julian: The one called Flowdown?
- 10:42:11 From Darcy Barron (she/her) to Everyone : yes
- 10:48:15 From Sigurd Naess to Everyone : How easy is it to get snow off large solar panel arrays like this? Would one use power from the diesel generator to melt it so that manual wiping can be avoided?
- 10:49:53 From Scott Paine to Everyone : Our experience in the past was that solar arrays cleared on their own very quickly
- 10:50:28 From Darcy Barron (she/her) to Everyone : Snow does not last long at the site and sublimates away pretty quickly
- 10:51:57 From Patricio Gallardo to Everyone : How much power will the PVs generate?
- 10:52:00 From Sigurd Naess to Everyone : Ok, thanks. I remember seeing scary images of lots of snow on and around ACT, so I thought that might take a while to go away. But the air is super-dry, so sublimation makes sense
- 10:52:07 From Sigurd Naess to Everyone : Just like the mcmurdo dry valleys
- 10:52:51 From Nicholas Battaglia to Everyone : What about linking to ALMA power?
- 10:53:01 From Alessandro Schillaci to Everyone : Snow can stay up to 2 or 3 weeks
- 10:53:41 From Jeff McMahan to Everyone : Someone— Mark? Told me that snow drifts is what causes the large buildups of snow— the solar panels will be off the ground and relatively immune to this
- 10:53:57 From Alessandro Schillaci to Everyone : especially in some section of the roads from Paso Jama e on the plateau road coming from ALMA
- 10:54:25 From Darcy Barron (she/her) to Everyone : Yes snow is a great insulator to keep snow drifts around for longer. Snow on relatively warm surfaces with good sun exposure doesn't last long.

- 10:54:29 From Sigurd Naess to Everyone : Linking to ALMA power is the obvious solution. If ACT could have done that we could have avoided a lot of downtime. But I think ALMA hasn't been receptive
- 10:55:44 From Alessandro Schillaci to Everyone : I confirm the drifts formation (got stuck at the site one time...)
- 10:55:55 From Paul Grimes to Everyone : Even in NE USA, you can see that PV arrays on houses tend to clear much faster than the roofs they are on - the panels still absorb sunlight through moderate snow depth, and heat up more than e.g. asphalt shingles, as well as still generating some power. That tends to help snow slide off of sloped panels. Although I guess the panels in Chile won't be as steeply sloped as here at 44°N.
- 10:56:30 From Stephen Parshley to Everyone : Current ALMA leadership is not interested in becoming a utility company. We (CCAT) tried to pursue this.
- 10:56:30 From Benjamin L. Schmitt to Everyone : I will throw out there that there is a natural gas pipeline that runs from Argentina to the Chilean Pacific Coastline that passes only a few km from the Chajnantor plateau region
- 10:57:11 From Scott Paine to Everyone : We ran a solar powered facility just to the north on Sairecabur for a number of years. Snow on the solar arrays clears almost as soon as the sun comes out. The ground was another story!
- 10:57:28 From Nicholas Battaglia to Everyone : Has S4 approached ALMA?
- 10:57:29 From Paul Grimes to Everyone : There are also snow clearing systems for PV arrays if required.
- 10:58:12 From Grant Tepy to Everyone : There's more than just matching voltage and frequency. There is also load matching. I think with SO there is some penalty with not running our generators at full capacity
- 10:58:40 From Sigurd Naess to Everyone : Having something aside from diesel to rely on sounds good. Diesel generator failure was a problem both for QUIET and ACT.
- 10:59:41 From Sigurd Naess to Everyone : Surprisingly many things can go wrong, e.g. the diesel delivery was missing the antifrost stuff at least once in QUIET, causing it to solidify inside the generator
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Kam notes during Amy's talk for his talk:

- Say scope is the same, with the difference that there are no SATs in the Chile preliminary baseline design. Logistics are all different, but in terms of scope, they live here.
- Refer to Amy's power and data rate table.
- Note high bay does not dock to telescope in Chile.

Parallel Notes:

Chile

- Lessons learned from foundation design of SO, would not use exact foundation design or telescope ring.
- Less than 1 minute latency on high bandwidth connection for data transfer to US
 - Tested from ALMA AOS to NERSC, was 10s of ms latency
 - Design is to do immediate work with the data in N. America
- Data goes on fiber to AOS technical building, and then goes on same fibers as ALMA data back to Santiago (MOU in place)
- Water cooled readout is not currently in requirements, need to add.
 - Need a requirement on temperature stability
 - May need a separate chiller for just readout to meet this stability requirement
- LAT will provide compressed air for DR, we need dry air or nitrogen for the lab
- Power at Chile is 50Hz. Power at pole is 60Hz. Will be split between sites.
- Marion: for facility with 4 generators... who deals with maintenance and updates?
 - We hire a generator maintenance person. During construction, significant fraction of a person to get it up and running, maybe 0.5 FTE during ops
- Tyler: how long is the on-site supply good for if supply is interrupted?
 - At least 2 weeks in requirements, ~ 3 weeks in reality
- Payback time of PV plant is on the order of S4 operations time
- Chilean project office... legal representative in Chile
- Nick: Power generation. Heat plumes near the telescope?
 - Would like to have a requirement, discussed a lot for SO, but never came to a requirement.
- Tyler: Run on PV and get diesel as needed?
 - Would always keep supply of diesel topped off

Pole: layout

- No obstructions 2 degrees above lip in groundshield.
 - If there were to be ground pickup sources, line them up in azimuth
 - Tyler: why important to keep MAPO?
- $(MAX_SPLAT-A)/B < \tan(2 \text{ deg})$
- Does calibration flow into site requirements? Kirit going to tell us something about that.
- Keep-out for SPLAT. 100 meters needs to be formalized more.
- Marion: The IceCube detectors and their expansion? Is that a constraint? Amy: absolutely, this map does not include the upgrade strings.
 - Is it an issue to drive heavy vehicles over a cable? Don't know if it's an issue to build on or drive over cables.
 - Erik: there are water tanks over top (the two double-dots). Definitely can't be on those.
- In a recent SAT meeting, talked about putting them in-line with DSL.
- Amy: one thing wondering about is using MAPO to support all 6 SATs.
- Nick: SPT keepout zone: what grade levels is that based on? Amy: really fuzzy, eeds to be iterated. Amy would like to send some simulated group pickup maps to SPT.

- Kirit: notes that they really end up not using az range for science in BICEP. Have to think about that for Chile. Kirit doesn't have a full answer.

Erik Nichols SAT Tower & Blue buildings

- Kam: notes but doesn't say: Amy, your idea to put all 6 on one access makes a lot of sense to me looking at that picture.
- Tyler; Are the blue buildings fabbed by someone specific, or just designed and reused
 - Originally designed by contractor, standard design with shell
 - Not specific to any vendor, purchase steel and panel from vendors
- Marion: Existing infrastructure is minimal in terms of personnel facilities (comfort) like kitchen, sleeping, bathroom
 - No requirements on that right now, current assumption is that construction grade outbuildings will support construction (warm up shacks, outhouses), but no permanent comfort facilities planned
 - It is a challenge having these away from the elevated station
 - Need to be sure to support the people working out there

Nick Emerson SPLAT Highway

SAT/LAT Calibration Infrastructure (Kirit Kakare & Johanna Nagy)

- SATs
 - Far-field measurements with re-directing flat mirror to observe source on mast
 - Kam: Mast is deployed for observations & then taken down? Correct
 - Mast needs to be ~ 200 m away
 - Tyler: Given that you still see SPT, does that mess you up?
 - Would rather have no obstructions, in practice you mask it out
 - Kam: could the source be 5-10 km away?
 - It would get much fainter. Main beam measurements want the thermal source to match spectrum of CMB, which constrains to closer measurement
 - Need a geometry study on height of mast for far-sidelobe measurements
 - Need infrastructure to support getting calibrators up into the groundshield - this seems like an important site scope thing.
 - Tyler: Why is FTS required to happen at pole? Is it just a loading issue?
 - In practice use the aluminum transition
 - Has to do with operating mode
 - Space in the lab is at a premium, so that's another consideration
- LATs
 - No firm plans laser tracker vs tower. Would need to provide tower spec.
 - Kam: holography tower is a nearby tower? Constructed for construction period and then taken apart after?
 - Nick: ALMA had a 50 m tower 300 m away used for commissioning at the OSF,

- Probably disappear for commissioning
 - Kam: calibrators far away for side lobes and polarization angle?
 - Can the LAT look low enough? Yes for SO LAT? Would that be reasonable rather than putting it on a tower?
 - Amy: self-calibration?
 - What about sidelobes? What level do we need to measure them?
 - Source on-site or celestial
 - Kam... open up the far field in consideration? Don't assume impossible for Chile?

Commissioning Requirements

- Gil: most of project completion is based on 'acceptance', can include some aspects of commissioning, but hopefully not very many?
 - Hopefully we can some pre-operations due to staggered nature of schedule?
- Kam: vendor installs telescope and we accept it.
 - Will also be closing out project cost accounts in the same way as they hit the site
- Gil: when build apparatus and deliver, there is a QC/QA then ship to site, then process at the site, then project accepts it.
- Amy: we are going to assemble on-site, and then there is another quality control, then we do final "acceptance"?
- Gil: started pre-operations 5 years before CD4 on last project. Jeff: for NSF this line is very bright. That's going to be a very important statement. That's a different thing than intra-project acceptance.
- Tyler: overloading the word commissioning
 - Commissioning here is first for the telescope with the small receiver, next is with the full receiver integrated with the telescope
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 - Planning to be in a mode of well-documented receivers coming from N. America, try to avoid doing things on site due to the cost of that work
 - Some detector characteristics do not need to be measured, Spot checks.
 - How much disassembly before shipping? This is important.
 - Amy: for LATs, plan is to leave optics tubs in and brace them, but ship the detector modules separately.
 - Joanna: experience from SPIDER, felt they had to do it post-assembly because they're pulling things out for shipping and then putting it back together.
 - Marion: things happen, so there's strong motivation to be fully equipped on-site.
 - Tyler: those are good points. Would be good to have historical
 - Kirit: solid example is LPE filters delaminating and seriously messing up spectra. Things happen that you don't expect.
 - Tyler: points toward spot checking being a valuable view of this.

Notes on report-back

- Reijo: if we could demonstrate that the atmospheric noise is correlated, is there a possibility of moving them further from each other?
 - Could it be 100 meters? Amy: hundreds is doable, but really need to understand how well-motivated it is.
 - SATs 1-3, part of the same superstructure.
- John: data can answer this question. That's the right way to see.
- Clem: multiple detectors within the telescope. This is not a huge deal.
- Bobby comments: "No big deal" needs to be quantified and documented
- Clem responds: Hi Bobby. I will send you a link right now. Further quantification and study is needed as discussed yesterday.
- Don Petravick asks: Does that mean SP computing need to be constrained to 120V?
- Brad answers: It's all 60Hz at Pole, but electricians can install anything, e.g., all our compressors run on 60 Hz, 220 V, 60 Amp circuits
- Tony responds: South Pole is 240 V split phase, just like normal US house power. A 240 V 60 Hz power receptacle can be specified wherever needed.
- Bobby asks: where does acceptance of components occur? Port, pole? Amy responds: At pole when assembled. Bobby: sites are also responsible for shipping. But I do agree. Amy: We don't want to close out until final assembly.
- John K: How much calibration is necessary before acceptance? Is it reasonable to demonstrate the apparatus vs true science calibration. Amy: I understand it to be operations.
- Question later in the chat from Maria on seismic requirements

Chat during report-back (pacific time):

- 08:28:08 From Donald Petravick to Everyone : Does that mean SP computing need to be constrained to 120V?
- 08:29:43 From Bradford Benson (he/him) to Everyone : Its all 60Hz at Pole, but electricians can install anything, e.g., all our compressors run on 60 Hz, 220 V, 60 Amp circuits
- 08:29:55 From Donald Petravick to Everyone : ok.
- 08:31:01 From Antony Stark to Everyone : South Pole is 240 V split phase, just like normal US house power. A 240 V 60 Hz power receptacle can be specified wherever needed.
- 08:37:46 From Maria Salatino to Everyone : question to Kam: Chile is a high risk country for earthquake: are we taking this into account for the site construction-facilities ect etc?
- 08:48:04 From Kam Arnold (he/him) to Everyone : On earthquakes: yes, seismic loads drive the requirements for the LAT foundation. Chile has a very robust civil engineering documentation and analysis of risk, and then we base the design on reducing probability of a destruction event to a low enough level.
- 08:48:25 From Maria Salatino to Everyone : thank you!

