



UNIVERSITY of HAWAI'I*at HILO
CENTER FOR MAUNAKEA
STEWARDSHIP

- Date proposal rec'd: 1/10/2024
- Type **A** / B / C
- CMS MIP #345
- KKM: Reviewed as 3YP; no further consultation
- Env Committee: N/A
- MKMB FYI: 3/5/2024
- OCCL: N/A

MEMO

March 5, 2024

To: Greg Chun

From: CMS Staff

SUBJECT: VLBA Request to Replace GPS Unit

VLBA requests to install a GPS antenna on its building roofline and a junction box to the building which will improve precision in data processing over the existing GPS unit. The VLBA is one of a series of ten telescopes across the United States (US) and US Virgin Islands and this new GPS will improve synchronization between and calibration across all sites.

CMS identifies the land use in accordance with HAR §13-5-22, P-8, Structures and Land Uses, Existing (A-1) *Minor repair, maintenance, and operation to an existing structure, facility, use, land, and equipment, whether it is nonconforming or permitted, that involves mostly cosmetic work or like-to-like replacement of component parts, and that results in negligible change to or impact to land, or a natural and cultural resource.*

VLBA was originally approved under CDUP HA-2174 issued in 1992. This request was included in VLBA's 2024-2026 Three-Year Outlook and Kahu Kū Mauna Council determined no further consultation was needed.

Installation will be done by up to four staff from the Applied Physical Laboratory at the University of Texas in Austin (ARLUT). A manlift may be involved for work occurring over ten feet above ground surface. The existing GPS unit will be kept in place as a back-up. No ground disturbance, expansion of facility footprint, change in use beyond the original approved use, or significant adverse impact to resources are anticipated. The change to physical appearance will be negligible. The attached project proposal and image slideshow provide further details.

Pursuant to the University of Hawai'i's 2022 Master Plan for the Science Reserve, CMS categorizes the request as Type A, Minimal Impact Project. Further, CMS' review of the installation complies with a variety of CMP actions, including:

- Natural Resources
 - NR-1: Limit threats to natural resources through management of permitted activities and uses.
- Education and Outreach
 - EO-2: Require orientation of users.
- Astronomical Resources
 - AR-2: Prevent light pollution, radio frequency interference (RFI) and dust.
- Permitting and Enforcement
 - P-1: Comply with all applicable federal, state, and local laws, regulations, and permit conditions related to activities in the UH Management Areas.
 - P-2: Strengthen CMP implementation by recommending to the BLNR that the CMP conditions be included in any Conservation District Use Permit or other permit.
 - P-4: Educate management staff and users of the mountain about all applicable rules and permit requirements.
- Infrastructure and Maintenance
 - IM-2: Reduce impacts from operations and maintenance activities by educating personnel about Maunakea's unique resources.
- Construction Guidelines
 - C-2: Require use of Best Management Practices Plan for Construction Practices.
 - C-7: Education regarding historical and cultural significance.
 - C-8: Education regarding environment, ecology and natural resources.
 - C-9: Inspection of construction materials.

CMS recommends the project be allowed to proceed with the following conditions:

Prepare to Start the Project

- CMS will provide a written notice explicitly verifying if the project is approved to commence (i.e., "Notice to proceed" will be issued); no project work may commence before this time.
- Project approval may not be transferred or assigned without prior authorization. A copy of the approval/permit must be present on-site and available for review at all times while working on UH-managed lands.
- Notify CMS via email to cmshilo@hawaii.edu at least 5 but no more than 14 days prior to beginning field work on UH-managed lands (Halepōhaku, Road Corridor, Maunakea Science Reserve, or Astronomy Precinct) when work will commence.
- No project notification will be accepted by CMS until all permit requirements are submitted to and approved by CMS. Any required Best Management Practices, Communication Plans, contract scope questions, etc. must be finalized and approved by CMS at least 5 days in advance of project commencement.
- Identify all contractors, vendors, suppliers, etc. anticipated to be associated with and substantively present on UH-managed lands at any time during the project.
- Attest that all individuals anticipated to be associated with the project have completed the Maunakea User Orientation prior to work.
- Identify the affiliated individual(s) who will be coordinating all invasive species inspections.

- Attest that the observatory or relevant entity will ensure compliance with all permit conditions and communicate with CMS if there is any uncertainty, and notify CMS in writing of other entities responsible for elements of compliance.
- State if a pre-project meeting with CMS is requested before work commences. Such a meeting is highly recommended for any project beyond activities completed by existing observatory staff. These meetings review orientation content, implications of project non-compliance, project-specific concerns regarding resource protection, health and safety, impacts to visitors, etc. They may be held in-person or via phone, webinar, or by other means.
- Identify and comply with other permit requirements, such as County of Hawai'i building permits or Department of Land & Natural Resources permits (see *both* any applicable DLNR permit and [HAR §13-5-42 Standard conditions](#)).
- No artificial lighting allowed from sunset to sunrise.
- Use of cell-phones, other than in airplane mode, is prohibited except in case of emergency.
- Allow CMS Rangers to visit and monitor activities.

Transportation and Motorized Equipment

- No use of mechanized equipment unless authorized by permit.
- Use of 4-wheel-drive vehicles required for travel above Halepōhaku.
- Motorized equipment, when stationary, must have a drain-pan in place suitable for catching fuel or fluid leaks.
- Large, heavy, non-4-wheel drive or oversized loads must submit notification to the Maunakea Road Conditions listserv at least one-day prior to delivery. Loads requiring an escort on public roadways must have this escort accompany them to the final destination. Projects failing to submit notification or arrange for escort to the summit may be denied entry.

Weather Conditions

- High wind conditions protocols must ensure debris and equipment are not blown from the job site. Projects occurring in the summit region must verify that temporary and permanent infrastructure can sustain 120 MPH winds.
- All improvements shall be designed and installed to withstand the severe weather conditions on the mountain.

Environmental Concerns

- Minimize dust released to the environment during equipment installation through use of a drop cloth placed under the wall exterior being drilled and also use of a vacuum cleaner held at the drill point.
- Remove and properly dispose of all waste material. All perishable items including food, food wrappers and containers, etc. must be removed from the site at the end of each day and properly disposed of.
- Ensure that loose tools or equipment are not left unattended at any time and are properly stored at the end of each day.

- Nēnē (*Branta sandvicensis*) may be present. If a nēnē appears within 100 feet (30.5 meters) of ongoing work, all activity shall be temporarily suspended until the animal leaves the area of its own accord. Feeding of nēnē is prohibited.

Invasive Species Prevention

- Identify the representative(s) in the initial notification who will be coordinating all invasive species related inspections.
- Employ invasive species prevention best practices, including inspections of materials by a DLNR-approved biologist, as identified in the Maunakea Invasive Species Management Plan prior to entering UH-managed lands. Inspections can only occur at locations where landowners have given permission (i.e. facilities, baseyards, and vendor locations). Inspections shall not occur on UH-managed lands on Maunakea, at State or County parks, along public roadsides, or on Department of Hawaiian Homelands lands.

Upon Project Completion

- The project must be completed within the time frame specified in the proposal and (when applicable) as approved by DLNR. Projects that cannot be completed within this timeframe are not allowed to continue (or commence) without explicit prior written approval from CMS.
- Notify CMS in writing when field activity associated with the project is completed. This notification must list all steps identified in the "notice to proceed" and explicitly communicate the status of completion.

Enclosures: 1. VLBA project proposal

Facility Project Proposal for the UH-Managed Lands

for projects anticipated to be classified as having “Minimal Impact”

Please mark all that apply to your project

- Project was reviewed in a 5- or 3-Year Plan
- Project is a CMP, lease, or sublease compliance measure (e.g., keeps the site in safe working order)
- Project involves heavy machinery (*involves manlift/bucket truck*)
- Project requires ground disturbance such as digging or trenching
- Project will result in a change to the facility footprint

Facility Name

Very Long Baseline Array (VLBA)

Brief Descriptive Title of Project

VLBA GPS Antenna

Project Description

Install a GPS antenna on the VLBA building roofline. Attach a junction box to the outside of the VLBA building. Attach both to existing VLBA grounding system.

Proposed Commencement Date

June 2024

Proposed Completion Date

June 2024

Estimated Project Cost

\$25,000

Total size / area of proposed use

Zero net area used; a junction box will be installed on the northeast side of the VLBA building and the antenna on the northeast roofline near the crest of the roof. No new land area will be developed.

Project Purpose and Need

The VLBA is an array of ten radio antennas which operate collectively as an interferometer. For interferometry to be successful, the signals need to be synchronized. The timing system on the VLBA makes use of a free-running hydrogen maser as its fundamental clock and then relies on comparison with GPS time to determine how far in error the maser clock is from truth. Corrections are then applied in data processing. The GPS system currently in use requires approximately 24 hours of data to determine clock corrections. The new system being deployed to the VLBA will allow clock solutions to be determined on far shorter timescales. This will allow discovery of timing problems much sooner. The improved precision will also support another VLBA initiative: real-time data transfer and processing. In the next several years it is expected that the VLBA will have the capability to send all of its data in real time to the central processor. In this operational mode, clock solutions with lower latency will improve data quality.

In summary, this will serve as a **replacement** of the existing GPS system used at the VLBA and will result in enhanced scientific results. The existing GPS system will remain on site and will be used as a back-up. It will also aid VLBA operations in identifying problems with the VLBA timing system on a much shorter timescale.

Has professional peer-review occurred

Yes. Multiple scientific agencies (NRAO, NOAA & NGS) have reviewed the installation plans that were prepared by the ARLUT and have reviewed approved the installation methodology and site plan.

Are there any related ongoing, pending, or planned projects associated with this submission?

Yes. This will be the last of 10 nearly identical installations: each of the 10 VLBA antennas, which are spread across the US and US Virgin Islands, will receive such an installation. There are no other ongoing, pending, planned related projects within Hawaii.

Description of the Project

Location

The installed equipment will be installed on the North East wall and roofline of the VLBA building. Please see associated "SitePlan.pdf" document for details specific to the Mauna Kea VLBA site installation. The installation made at the Owens Valley, CA VLBA site is shown in the photo below. The installation at the VLBA antenna on Mauna Kea will look substantially identical.



Description of the process of completing the project

Standard brackets will be used to attach the antenna mast and junction box to the side of the VLBA building. Details on the installation practice can be found in the accompanying “InstallNotes.pdf” document.

Who will do the work?

Three or four visitors from the Applied Physics Laboratory at the University of Texas (ARLUT), Austin, will perform the installation.

Equipment & Transportation

One bucket truck / manlift will be used in the installation. This installation can be done on ladder, but it was deemed safer and more comfortable with this equipment.

Measures to protect the environment and/or mitigate impacts

Impacts

Please see the accompanying “InstallNotes.pdf” for a full description. The only environmental hazard identified is drilling into the cinder blocks that comprise the building shell. A shop vacuum cleaner will be held at the drill point and a drop cloth will be positioned under the area being drilled to capture debris not collected by the vacuum.

Compliance with Lease, Sublease, or Comprehensive Management Plan (CMP)

Please see the CMP matrix spreadsheet.

Identify other required or associated permits

None identified.

Community Benefits

Benefits to other Maunakea entities and/or global astronomy community

The primary benefit of this installation is to improve calibration of the VLBA. For this to be effective, all ten VLBA antennas must be outfitted with the same equipment. The calibration improvements come in two separate ways. First, the GPS antenna will provide a superior timing signal (accurate to 10 nanoseconds within every 10 second integration period) that will improve synchronization across the VLBA array. Second, the GPS antenna will be receiving signals from 30 or more GPS satellites (and similar navigation satellites) spanning the sky which can be used to perform direction-dependent calibration. The net result is improved astrometry (ability to measure angles on the sky) and improved calibration of very faint sources which require calibration to be transferred from one celestial source to another.

Benefits to the Hawaii Island community

One use of the VLBA that will be greatly improved is generation and maintenance of the celestial reference frame. This frame is defined by very distant quasars and is essential to the calibration of the GPS system as a whole. The GPS receiver will also generate a time series of position measurements that very precisely map the motion of the antenna (and thus the local surface) as a function of time. This information can inform geologists about volcanic ground motion and plate tectonics.

Will data, publications, or other products be free and available to the public?

Raw data from this system will be made publicly available. All VLBA science data becomes publicly available within 1 year (or less) of observation.

For internal use only by CMS

Review checklist

Y Staff review and report

n/a Outside agency review or approval required

n/a Environment committee, if environmental impacts are anticipated

n/a Kahu Ku Mauna, if cultural impacts are anticipated and KKM requested consultation, or the project was not included in a 5YP or 3YP

FYI only Maunakea Management Board