



# Atacama Large Millimeter / submillimeter Array

## NA ALMA Construction – Antenna IPT NA Antenna Surface Accuracy & Thermal Performance Review – Oct 2014 Review Panel Terms of Reference

ANTD-35.22.00.00-0002-A-PLA

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2014-10-21

Prepared by:	Organization:	Date:
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### Change Record

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## 1 Introduction

### 1.1 Background & Purpose

The twenty-five North American ALMA 12 meter antennas are now delivered by General Dynamics-Vertex Antennentechnik and are in use in the ALMA array. For some years, astro-holography measurements carried out at the Array Operations Site (AOS) have indicated that the antennas are exhibiting astigmatism, and that the surface accuracy does not appear to meet ALMA specifications over the required temperature range of operation. Analysis of an extensive set of astro-holography measurements has now been completed to further quantify the performance of the NA antennas over a range of ambient operating conditions. These measurements indicate that a substantial number of the NA antennas do not meet the delivery specification of 25  $\mu\text{m}$  RMS surface accuracy over the specified ambient temperature operations range of  $\pm 20$  C. The surface accuracy failure typically manifests itself as an astigmatism feature. Failure to meet the surface accuracy specification will have an impact on ALMA observing performance – in efficiency and fidelity – affecting particularly the highest frequency observations.

The North American ALMA Antenna IPT is convening a review panel to examine the surface accuracy performance due bulk thermal changes of the NA ALMA (Vertex) antennas, the data and analysis methods, conclusions, and path forward. The review will be conducted collaboratively, with the objective of determining root cause of any agreed deficiencies, and path forward to correction. No pre-determinations or conclusions are made at the outset.



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The following sections provide the Panel makeup, meeting venue, and specific charges for the review.

### 1.2 Logistics and Agenda

The logistics and meeting agenda will be linked from the following wiki page, and will be updated frequently:

<https://safe.nrao.edu/wiki/bin/view/ALMA/NAAlmaAntennasOct2014>

### 1.3 Venue

The review meeting will be held at NRAO-Charlottesville (Virginia, USA), at the Edgemont Road Building Auditorium. Further information and links to directions may be found on the wiki link above.

### 1.4 Date

The review will be held on 27-29 October 2014. The meeting is planned for 2 ½ days, beginning on the morning of Monday, 27 October, and ending at approximately noon on Wednesday, 29 October. Agenda updates will be posted on the wiki.

### 1.5 Panel Members and Expected Attendees

The review panel will consist of the following members, chaired by Dr. David P. Woody (Caltech). Other members may be added prior to the review.

Panel Member	Affiliation	Email
David Woody (Chair)	Caltech	<a href="mailto:dwoody@caltech.edu">dwoody@caltech.edu</a>
Shin'ichiro Asayama	NAOJ	<a href="mailto:shinichiro.asayama@nao.ac.jp">shinichiro.asayama@nao.ac.jp</a>
Jaap Baars	MPIfR	<a href="mailto:jacobbaars@arcor.de">jacobbaars@arcor.de</a>
Darrel Emerson	NRAO	<a href="mailto:demerson@nrao.edu">demerson@nrao.edu</a>
Richard Hills	MRAO-Cambridge (ex-JAO)	<a href="mailto:richard@mrao.cam.ac.uk">richard@mrao.cam.ac.uk</a>
Michael Kesteven	CSIRO	<a href="mailto:Michael.Kesteven@csiro.au">Michael.Kesteven@csiro.au</a>
Robert Laing	ESO	<a href="mailto:rlaing@eso.org">rlaing@eso.org</a>
Japie Ludick	SKA – SA	<a href="mailto:japie@ska.ac.za">japie@ska.ac.za</a>
Peter Napier (by video)	NRAO	<a href="mailto:pnapier@nrao.edu">pnapier@nrao.edu</a>
Steve Padin	Caltech	<a href="mailto:spadin@caltech.edu">spadin@caltech.edu</a>
Nick Whyborn	JAO	<a href="mailto:nwhyborn@alma.cl">nwhyborn@alma.cl</a>



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### 1.6 *Presenters*

The review presentations will be agreed with the panel chair and listed on the agenda prior to the review.

### 1.7 *Observers and At-Large Attendees*

The following people have been invited to attend the review as at-large members and may contribute to discussions with the agreement of the panel chair.

#### **NRAO / NA ALMA Management & Staff**

T. Beasley, NRAO Director  
P. Jewell, NA ALMA Director, NRAO Deputy Director  
W. Randolph, NA ALMA Construction Project Manager  
A. Symmes, NRAO / NA ALMA Chief Antenna Engineer  
J. Mangum, NRAO Scientist, NA ALMA Antenna IPT  
A. Wootten, NA ALMA Program Scientist  
F. Schwab, NRAO Scientist, NA ALMA Antenna IPT

#### **Joint ALMA Observatory Management & Staff**

S. Corder, JAO Deputy Director (attending by video)  
S. Guniat, Head, ALMA Dept. of Engineering  
M. Sugimoto, JAO Engineer

#### **EU ALMA Operations**

No expected attendees

#### **EA ALMA Operations Manager**

S. Sakamoto, EA Integrated Engineering Team Manager

#### **General Dynamics Vertex Antennentechnik**

S. Lucy, GD Satcom Technologies (Kilgore), ALMA Program Manager  
K. Pausch, Managing Director, Vertex Antennentechnik  
P. Fasel, Director Operations & Engineering, Vertex Antennentechnik

#### **Invited Observer**

J. Zivick, CCAT Project Manager

### 1.8 *Review Format*

The review will be open to participation and collaboration by panelists and invited guests. Some participants may attend by video teleconference. The panel chair shall have final



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authority on format and moderation of the review, including any adjustments deemed necessary.

### 1.9 *Review Materials*

Review materials and presentations will be posted on the review wiki or sent to participants by separate email.

## 2 Charges to the Panel

This panel shall function as a working, fact-finding committee, whose role is to advise NRAO and ALMA on the surface accuracy of the NA ALMA antennas as a function of bulk thermal changes and recommend corrective paths, as may be necessary. The relevant ALMA antenna performance specifications will be provided. The charges to the panel are:

1. Evaluate the measurements of NA ALMA antenna surface accuracy performance for their accuracy. If the consensus is that the measurements are not sufficient to determine compliance with the surface specification then suggest any further measurements that may be warranted to verify the techniques.
2. Based on presented data, evaluate the performance of the NA ALMA (GD –Vertex) antennas as a function of bulk thermal changes as it pertains to ALMA specifications for surface accuracy performance. To the best of its ability, the panel shall
  - a. Determine root cause(s) of any deficiencies determined;
  - b. If insufficient data exist to determine root cause, recommend further measurements or experiments to determine root cause and paths toward correction.
  - c. Recommend best path(s) toward correction
3. Provide any other recommendations that may assist this investigation or improve the performance of the NA Vertex ALMA antennas.
4. A written report on the findings of the panel shall be submitted to the NRAO Director within one month of the conclusion of the review.