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Addendum to
ALMA Antenna Technical Working Group Report

2004 - November 17

Signatures of the Evaluation Team Members

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1. INTRODUCTION AND SCOPE

This addendum is a follow up to the initial ATWG report of September 29, 2004 concerning new information and measurements that have become available as described below. This information is evaluated in the context of the original report and the ALMA technical specifications.

1.1 NEW MATERIAL

1.1.1 VERTEXRSI PROPOSAL

New photogrammetry measurements were undertaken by Vertex in October 2004 as well as new quadrant detector measurements by the AEG. Before these measurements were performed, Vertex inspected the torque on all of the bolts and tightened a large number of bolts that were found to out of specification. Vertex submitted several reports on this work and the detailed AEG measurements were made available to the ATWG.

1.1.2 ALENIA PROPOSAL

Alenia submitted a responses to specific questions raised concerning their proposal metrology system.

1.2 CHARGE TO THE COMMITTEE

No new charge was given to the committee and the previous charge is assumed to apply.

1.3 METHODOLOGY

The methodology is the same as for the ATWG report of September 29, 2004.

1.4 RELATIONSHIP TO PREVIOUS REPORT

All of the conclusions and statements from the September 29, 2004 report remain unchanged excepted for the areas explicitly covered in the following sections.

2. WILL THE PROPOSED ANTENNA DESIGNS MAINTAIN SURFACE ACCURACY SPECIFICATIONS OVER ALL ELEVATION RANGES?

2.1 THE VERTEXRSI ANTENNA

The gravitational deformation of the VertexRSI antenna was a major concern of the ATWG. At the time of the original report the information was insufficient to determine whether the antenna met the demanding ALMA surface specifications, in particular there were indications that the FEM provided by Vertex did not accurately predict the deformations. The new measurements were intended to give a more accurate comparison between the prototype deformations and the VertexRSI FEM.

Our conclusion is that the photogrammetry and quadrant detector measurements indicate that the BUS deformations are as much as 1.3 times larger than predicted by the FEM. This is based on several analyses that are not yet complete and it still remains to verify the all of the corrections and algorithms are correct. Nevertheless it is also true that a significant non-homologous astigmatic deformation is detected. This astigmatism is not predicted by the FEM and indicates the difficulty of arriving at a correction to the non-homologous gravity contribution to the surface error budget. Following the methodology of the first ATWG report we have scaled the gravity component from the Vertex error budget by 1.5 to incorporate these non-homologous effects for both the gravity and wind. This is the same correction as we had in the first report and gives a net surface RMS of 24.5 microns.

The photogrammetry data has also been analyzed to obtain an estimate of the upper limit to the non-homologous gravitational deformations by using the consistency between different maps as a measure of the photogrammetry measurement errors. This estimated upper limit is 12.5 microns assuming that the panel setting can be fully optimized to minimize the effects of these errors. This estimate also assumes that there are no systematic effects in the photogrammetry that would give different answers depending upon where and when the photographs are taken. Replacing the VertexRSI gravity deformation component of 6.2 microns with this upper limit and applying the global scaling factor of 1.3 to the wind deformations yields an estimated surface RMS of 25.1 microns.

It is worth noting that all indications are that the tightening of bolts on the antenna improved the gravitational performance of the telescope. The photogrammetry from 2004, old quadrant detector data and the out-of-focus holography maps taken early in 2004 all indicate larger gravitational deformations than are seen now.

The following concern expressed in the original summary still remains. “We also have a concern that, with no temperature regulation in the walls of the receiver cabin, the gradients may be larger than assumed and that this would cause excess deformations in the dish.”

2.2 ALENIA PROPOSAL

No new information supplied

3. TO WHAT EXTENT CAN THE PROPOSED METROLOGY SYSTEMS RELIABLY IMPROVE THE POINTING PERFORMANCE OF THE PROPOSED ANTENNA DESIGNS IN ORDER TO MEET THE REQUIRED ALMA POINTING SPECIFICATIONS?

3.1 VERTEXRSI PROPOSAL

No new information supplied.

3.2 ALENIA PROPOSAL

The new calculations from Alenia indicate that the revised metrology system should work. We support their new approach and it should be possible to retire or mitigate the risk soon after the first article is delivered.