MILLIMETER ARRAY/ALMA-US
DESIGN AND DEVELOPMENT

MONTHLY REPORT
MONTH END MAY 2001

1 Executive Summary

The rapid integration of the Japanese into the ALMA project continued to accelerate this month with the joint meeting of the Division Heads and Team Leaders from all three partners at the Observatoire de Paris. The purpose of the meeting was to explore, in each area, the most promising methods of partitioning the work among the three partners. The meeting was also an opportunity for team building among the geographically dispersed groups. A major conclusion of this meeting was that the project would benefit from regular meetings of this type. Periodic face-to-face meetings of the Division Heads and Team Leaders are now being planned.

In addition to this *sociological* progress, the group reached consensus on a number of specific questions posed by the Expanded ALMA Executive Committee (EAEC). In particular, the IPT model promoted for the bilateral project was found to be extendable for the tripartite project. The group also reached consensus on a "Customer/Vendor" model for components supplied by one group for integration into a larger subsystem by a second partner.

We were disappointed this month to learn that the prototype antenna supplied by VertexRSI will be delayed from January to April 23, 2002. An unanticipated number of design iterations were required to reach an optimum design for the carbon fiber backup structure segment. With these iterations, and the overall design now complete, VertexRSI reviewed the detailed fabrication schedule and determined they could not recover the additional time spent in the design phase. It remains our consensus that, despite the delays, Vertex is producing an excellent antenna.

The most recent estimate for the delivery of the EIE antenna to the VLA site is August 2002. Given these delays, we are reassessing our planning for the early part of 2002. We will continue to press to complete all of the antenna evaluation hardware and site development activities on the current schedule. During the first quarter of 2002, we will use the resources originally assigned to antenna evaluation to accelerate already planned design activities for prototypes of the production versions of the front ends, LO and IF modules. In this way, the time lost due to prototype antenna delivery will be partially recovered by accelerating completion of other tasks.

2 Programmatics

2.1 Financial Statement

[Not Included.]

2.2 Personnel

The ALMA Project staffing is reported by WBS Level-1 category based on the joint project WBS. The total number of full-time equivalent employees was 63.3.

2.3 Progress Against Project Milestones

Attached to this report is the Project Gantt chart displaying the summary-level tasks of the Phase 1 Project WBS. For each of these summary tasks the progress against the baseline is reported as a percent complete. The same information is shown graphically; progress is reported as horizontal bars colored green; work still pending is shown in black or solid blue. Milestones are indicated by triangles, colored green for completed milestones and colored red for pending milestones. A vertical red line is used to indicate the date of the presentation; here progress is reported as of 14 December 2000.

In May, only one major milestone was scheduled for completion. This was to Pump a 490 GHz SIS Mixer Photonically (WBS 5.1.18.10). This milestone was completed on time.

3 Meetings And Memos

3.1 Meetings Held During May 2001

Joint Tri-Project Face-to-Face Meeting - May 10 - 12 - Paris, France
Progress on Photonic Systems for ALMA - May 17 - Bonn, Germany

ALMA US DH Teleconference - May 14, 21
ALMA Joint DH Meeting - May 29
ALMA US ASAC Teleconference - May 30
ASAC Teleconference -
EAEC Teleconferences
AEC/SE Teleconferences
ALMA Systems Group Teleconferences
ALMA Imaging & Calibration Teleconferences

3.2 Planned Meetings in June 2001

ALMA Management Advisory Committee Meeting - June 8 - 9 - Garching, Germany
EACC Meeting - June 11 - 12 - Garching, Germany
Calibration Meeting - June 21 - 22 - Cambridge, England
Tri-lateral Project Teleconference - June 25
ALMA US Division Head Teleconferences - June 04, 18
ALMA Tri-Project DH Teleconference - June 25
ASAC Teleconferences
EAEC Teleconferences
AEC/SE Teleconferences
ALMA Systems Group Weekly Teleconferences
ALMA Imaging & Calibration Teleconferences

3.3 ALMA Technical Memos Distributed in May 2001

369	Seasonal and Diurnal Variation of Upper Soil Resistivity in the Cerro Chascon Science Preserve	Seiichi Sakamoto
373	Relative Pointing Sensitivity at 30 and 90 GHz for the ALMA Test Interferometer	M. A. Holdaway and Jeff Mangum
374	Wide Field Imagings with the Atacama Large Millimeter/Submillimeter Array	Koh-Ichiro Morita
375	Coordinates of Roads, Pipelines, and Landmarks Near the ALMA Site	Seiichi Sakamoto
376	Integration of LO Drivers, Photonic Reference, and Central Reference Generator	Eric W. Bryerton, William Shillue, Dorsey L. Thacker, Robert Freund, Andrea Vaccari, James Jackson, Robert Long, Kamaljeet S. Saini, and Richard F. Bradley

The full catalog of the ALMA Memo Series can be found at the ALMA web site at http://www.alma.nrao.edu/memos/.

4 Technical Progress Reports

4.1 Antennas

At a meeting with VertexRSI management we were informed that the recent review of the production schedule for the prototype antenna was complete. We were informed that they were not able to realize a schedule recovery by accelerating the fabrication. The earlier delivery estimate of January 2002 was based on two optimistic assumptions; that the first bus segment would be completed in May and that the fabrication process could be accelerated to make up some of the additional time spent on design. For the BUS element, Vertex has taken a very careful and conservative approach of fabricating test pieces of critical elements and testing their performance. They have had to iterate the design, fabrication and retesting of a number of these elements to ensure adequate margin to meet all of the antenna requirements. These iterations were not part of the original schedule. The delay in acceptance of the first BUS element has also delayed final release for manufacture of several other major antenna components. Vertex believes they have resolved all of these issues.

In earlier discussions, we had understood that some of this delay could be recovered by shortening the fabrication time. With the detailed design now complete, Vertex has undertaken a review of its manufacturing plans. On the basis of this review, Vertex has concluded that it cannot shorten the process without taking unwise risks. At the same time, they have agreed to take several actions to assure they meet this schedule:

- Authorized overtime for engineering and drafting labor
- Secured a second source for fabrication of BUS segments
- Committed to using local German steel fabricators (rather than their own Estonian plant) for the fabrication of the pedestal and cabin

Vertex agreed to undertake all of these actions at no additional cost to NRAO.

Bernard Cahlander, Vice President of VertexRSI, clearly indicated that VertexRSI is committed to delivering a first class antenna that meets all of the specifications; he clearly expects to win the ALMA production contract. He has backed this up with additional company resources. They estimate that the actions noted above will cost the company about $500k. Our consensus is that VertexRSI is taking the actions needed to deliver the antenna on the new schedule. With these actions, this schedule is attainable.

It remains our consensus that, despite the delays, Vertex is producing an excellent antenna. We are particularly pleased that they have, in the prototype design process, maintained a focus on the end goal of large-scale production. They have paid careful attention to value engineering that should yield cost and schedule benefits during construction.

The AEG (Antenna Evaluation Group) held a meeting in Lund, Sweden this month. Details of planned antenna testing were discussed. A top level list of how the antenna specifications will be evaluated was developed. The option of using only three foundations on the VLA site was considered. We think this is a workable solution that

could save several hundred thousand dollars in foundation cost while incorporating the Japanese antenna. A report by the AEG group will be issued to the EAEC.

A meeting of the transporter group was held in Lund. Transporter concepts, specifications, configuration and future plans were discussed. The transporter ICD was reviewed and work on a Japanese transporter ICD was initiated.

4.2 Front End

Discussion at the Paris meeting of the Tripartite Division Heads and Team Leaders was very productive. A number of options were considered on the division of effort in the front end area. A consensus was reached that partners should be responsible for delivering completed, tested cartridges to one or more front end integrations centers.

Work is accelerating on construction of the evaluation receivers that will be used to test prototype antennas in the test interferometer. A review of the requirements based on the most recent antenna test plans identified some simplifications that will shorten the assembly and test time for these receivers. As the Evaluation Receivers will be used only for testing at the VLA site, minimizing the time spent on them can make resources available for other development activities sooner.

4.3 Local Oscillator System

Work is progressing on the Bias board for the LO Source and multipliers. The Keil Integrated Development Environment for the 166 microprocessor was installed on our lab development computer so we will be ready for the AMBSI-1 interface board which will be supplied by the computing group.

A successful end-to-end test of the baseline Photonic Reference has been completed. These measurements represent the first test of a local-oscillator (LO) driver based on a multiplied YIG-tuned oscillator (YTO) locked to a variable frequency photonic mm-wave reference. The reference is provided as a beatnote between two optical signals and is carried from a remote location by 10 meters of optical fiber to a photomixer at the LO driver site. Phase noise measurements were performed at about 80 GHz. A pre-prototype of the Central Reference Generator (CRG) developed in Socorro was also used in the tests as the fundamental reference from which all other sources were synchronized.

At the Photonics Meeting held this month in Bonn, Germany, results were presented of a successful test of a 490 GHz SIS junction pumped directly by a photonic mixer. While additional tests are required to characterize the noise performance, this is a major step forward in realizing a full photonic LO system. Such a system could significantly reduce the number of components and complexity of the ALMA LO system.

4.4 Backend Subsystem

The layout of the total power detector board was completed. The board has been sent out for fabrication. The distribution of gain/power/snr/headroom has been adjusted to make use of lower cost 4-12 GHz amplifiers. A detailed block diagram for the bench integration downconverter has been developed and an internal informal review of the bench integration downconverter was held.

4.5 Correlator

Layout of the correlator printed circuit board is moving forward. Progress is difficult due to very slow response of the ORCAD layout program resulting from the complexity of this board. All critical runs have been hand routed and the power and ground nets are routed. Most of the remaining runs will be auto routed.

Testing of the filter card continues. A software routine has been completed that will exactly predict the filter card output given a set of random inputs. This means that the tap weights are loaded correctly and the math in the summation of tap multiplier outputs is correct.

Testing of the Long Term Accumulator (LTA) is progressing. We can test very large parts of the LTA SDRAM and will soon proceed to the next step in card testing, testing the card output adder tree.

4.6 Computing

Four ALMA computing memos were reviewed and released during this month:

- *ALMA Test Correlator Control Computer Software Design* by Jim Pisano
- *ALMA Monitor and Control Bus AMBSI-1Standard Interface Design Description* by Mick Brooks
- *ALMA Monitor and Control Bus AMBSI2 Standard Interface Design Description* by Wayne Koski
- *ALMA Science Software Requirements and Use Cases* by Robert Lucas

4.7 Systems Engineering

We have begun to integrate the Japanese prototype antenna into the plans for the Test Interferometer. A weeklong ALMA TI planning meeting was held in Lund, Sweden. A trilateral consensus was reached regarding a revision to the TI antenna layout. We plan to place all three antennas on an EW baseline with a separation of 35m between antenna pads.

4.8 Imaging and Calibration

A visit was made this month to the ALMA site at Chajnantor. The visit included the following personnel: ESO/SEST/OSO/MRAO: John Conway, Guillermo Delgado, Lauri Haikala, Lars-Ake Nyman, Angel Otarola, Fredrik Rantakyro, Roberto Rivera, Yasmin Robson, Gie Han Tan. NRAO: Bryan Butler, Bill Cotton, Simon Radford. NRO/NAOJ/U. Tokyo: Kotaro Khono, Jin Koda, Seichi Sakamoto. MPIfR: Peter Schilke, Claudia Comito.

Activities carried out doing this campaign included:

a) Side-by-side test of the NRO 220 GHz and the NRAO 225 GHz tipping radiometers at the NRAO.
b) Repair of NRAO 12 GHz interferometer.
c) Deployment of repaired sub-mm tipper (NRAO).
d) Upgrade of control and data acquisition software for the 183 GHz radiometers (ESO).
e) Deployment of a high speed wind meter (ESO).
f) Radiosonde launches (UT 13, 16 and 24 on most days).
g) Exploration of Chajnantor area, including several trips around Cerro Chascon, for ALMA antenna locations.
h) Deployment of 64 kbps ISDN sat phone and Cisco router for connection to NRAO intranet. [Earlier satphone decommissioned.] Update of various utility software to support network access.
i) Deployment of ESO linux server with 4.8 kbps modem access over cell phone.
j) Visit to the OSF areas and exploration of the existing road.
k) Exploration for candidate sites for the APEX antenna.
l) Data retrieval.

The Project Scientists from all three partners met at the Tripartite Division Heads. Team Leaders meeting in Paris. There seems to be fairly good agreement among project scientists that although eventual SSB operation of all receivers is to be preferred, DSB operation at the highest frequencies will provide acceptable performance. Continuum observations favor DSB operation and many calibration procedures use continuum observations. If 70% or more of submillimeter observations were continuum, for example, there would be no sensitivity penalty for DSB operation. At 1.3mm this number drops to 20% or so.

The calibration strategy was discussed and approved for presentation at the Cambridge meeting on 21-22 June.

We also discussed the ACA, about which there is more disagreement. However, even the Japanese agree that the ACA will benefit a larger fraction of observations than any other single item except correlator and antenna--for instance it may be most useful in at least 25% of observations whereas any given receiver band of the “n’ total receiver bands, except perhaps 3mm, will benefit at best 1/n of the observations.

MILLIMETER ARRAY/ALMA-US

PROJECT STAFFING

MONTH END MAY 2001

WBS Task Name	Number Of Persons Participating in Activity*	Full-time Equivalent Employees
Administration	11	6.4
Site Development	1	0.0
Antennas	4	2.5
Front-End	22	18.3
Local Oscillator	11	8.8
IF and Fiber Optics	6	6.0
Correlator	5	4.0
Computing	9	8.5
System Integration	6	5.8
Calibration	3	3.0
TOTAL:	78.0	63.3

* Several persons in this column are counted two or more times. These particular individuals are involved part-time in more than one activity.

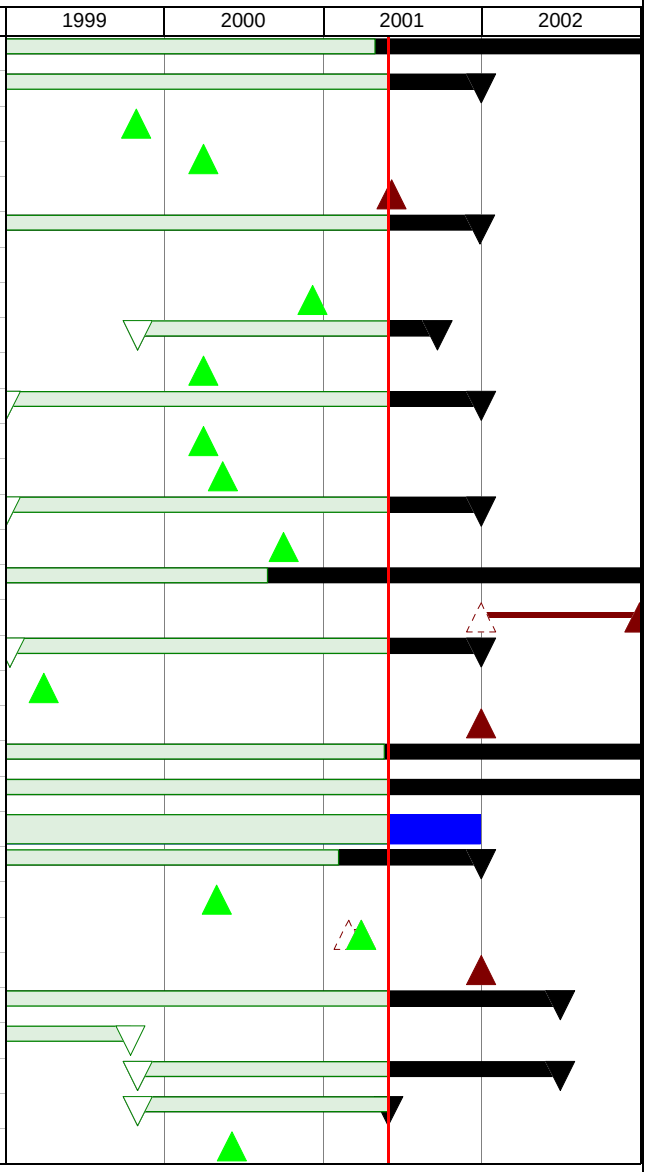
Atacama Large Millimeter Array

ALMA Milestone Progress

(as of 2001-05-30)

Selected Phase 1 Major Milestones and Tasks

Line	WBS (f)	Task	Start	Finish	%done
1	**1**	**Management/Administration**	1998-06-01	2010-12-31	52%
2	1.05	Phase 1 Management	1998-06-01	2001-12-31	84%
4	**1.05.10**	**Deliver WBS for ALMA D&D phase**	**1999-10-28**	**1999-10-28**	**100%**
6	**1.05.20**	**Deliver final WBS for ALMA project**	**2000-03-31**	**2000-03-31**	**100%**
7	**1.05.22**	**Review: ALMA Management Advisory Committee**	**2001-06-08**	**2001-06-08**	**0%**
8	1.05.25	Project Book	1998-06-01	2001-12-28	84%
10	**1.05.25.10**	**MMA Project Book: Version 1**	**1998-07-20**	**1998-07-20**	**100%**
11	**1.05.25.15**	**ALMA Project Book: Joint Version**	**2000-12-08**	**2000-12-08**	**100%**
12	1.05.30	Phase 1 Joint Management Plan	1999-11-01	2001-09-21	83%
14	**1.05.30.10**	**Deliver Phase 1 Joint Management Plan**	**2000-03-31**	**2000-03-31**	**100%**
54	1.10	Phase 2 Planning	1999-01-01	2001-12-31	77%
57	**1.10.15**	**Deliver Baseline Scope of Phase 2**	**2000-03-31**	**2000-03-31**	**100%**
59	**1.10.25**	**Deliver Draft Phase 2 Plan**	**2000-05-15**	**2000-05-15**	**100%**
61	1.10.35	Management Planning	1999-01-01	2001-12-31	82%
62	**1.10.35.05**	**Deliver Management Plan for Construction**	**2000-10-02**	**2000-10-02**	**100%**
77	1.20	Agreements in Chile	1998-06-01	2010-12-31	25%
79	**1.20.10**	**CONICYT Use Permissions**	**2002-12-31**	**2002-12-31**	**0%**
86	1.25	Partnerships and Agreements	1999-01-11	2001-12-31	77%
88	**1.25.10**	**Partnership Recommendations to NSF**	**1999-03-30**	**1999-03-30**	**100%**
91	**1.25.25**	**Final ALMA Partnership Agreements**	**2001-12-31**	**2001-12-31**	**0%**
97	**2**	**Site Development**	1998-06-01	2011-12-29	25%
98	2.05	Site Development Management	1998-06-01	2006-01-19	34%
99	2.05.03	Site Development Management Phase 1	1998-06-01	2001-12-28	84%
103	2.07	Site Development Requirements	1998-06-01	2001-12-31	96%
105	**2.07.10**	**Deliver Initial Operations Plan**	**2000-05-01**	**2000-05-01**	**100%**
106	**2.07.15**	**Deliver Revised Operations Plan**	**2001-03-30**	**2001-03-30**	**100%**
107	**2.07.20**	**Approval of the Operations Plan**	**2001-12-31**	**2001-12-31**	**0%**
108	2.10	Development Plans	1998-06-01	2002-07-01	85%
109	2.10.05	Prepare Preliminary Development Plan	1998-06-01	1999-10-15	100%
118	2.10.10	Estimate Development Costs	1999-11-01	2002-07-01	65%
119	2.10.10.05	Prepare Initial Plan	1999-11-01	2001-05-31	99%
127	**2.10.10.05.38**	**Deliver Initial Site Development Plan**	**2000-06-05**	**2000-06-05**	**100%**

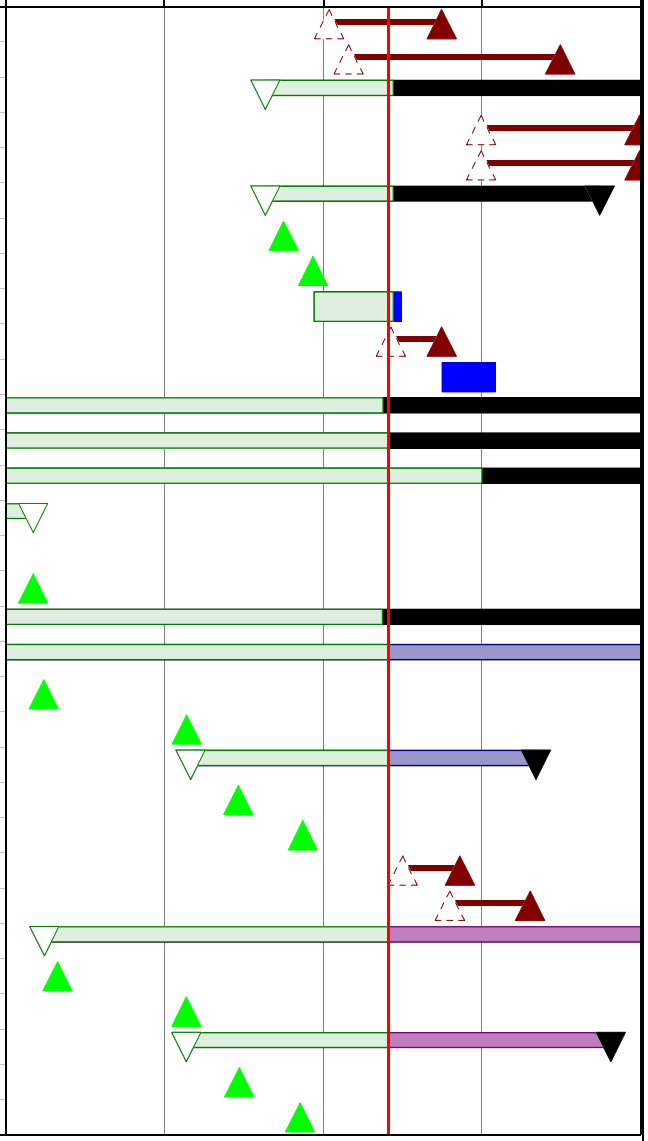


Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

ALMA Milestone Progress
(as of 2001-05-30)
Selected Phase 1 Major Milestones and Tasks

Line	WBS (f)	Task	Start	Finish	%done
137	**2.10.10.15**	**PDR: Site Development Plan**	**2001-10-01**	**2001-10-01**	**0%**
139	**2.10.10.25**	**Deliver revised development Plan**	**2002-07-01**	**2002-07-01**	**0%**
140	2.15	Site Legal Issues	2000-08-21	2011-12-29	5%
141	**2.15.05**	**(CONICYT Use Permissions Delivered from WBS 1)**	**2002-12-31**	**2002-12-31**	**0%**
142	**2.15.10**	**(Access to OSF Land Delivered from WBS 1)**	**2002-12-31**	**2002-12-31**	**0%**
143	2.15.15	Process Environmental Documents (EIA)	2000-08-21	2002-09-30	37%
145	**2.15.15.07**	**EIA Started**	**2000-10-02**	**2000-10-02**	**100%**
146	**2.15.15.10**	**Deliver Initial EIA**	**2000-12-09**	**2000-12-09**	**100%**
147	2.15.15.15	Complete EIA Documents	2000-12-11	2001-06-29	90%
148	**2.15.15.20**	**Submit EIA Documents to Chilean Authorities**	**2001-10-01**	**2001-10-01**	**0%**
149	2.15.15.25	EIA Approval Process	2001-10-02	2002-02-01	0%
254	**3**	**Antenna Subsystem**	1998-06-01	2010-12-31	28%
255	3.05	Antenna Management/Subsystem Engineering	1998-06-01	2010-12-31	20%
258	3.05.10	Antenna Subsystem Engineering	1998-06-01	2010-07-01	16%
259	3.05.10.05	Antenna Subsystem Design & Specification	1998-06-01	1999-03-05	100%
265	**3.05.10.05.30**	**Antenna PDR**	**1998-07-28**	**1998-07-28**	**100%**
267	**3.05.10.05.40**	**CDR: Antenna RFP/CfT**	**1999-03-05**	**1999-03-05**	**100%**
269	3.10	Prototype Antennas	1998-09-22	2003-09-19	57%
270	3.10.05	U.S. Prototype Antenna	1998-09-22	2003-06-02	47%
273	**3.10.05.15**	**Issue Prototype Antenna RFP**	**1999-03-30**	**1999-03-30**	**100%**
277	**3.10.05.35**	**Sign Contract (Prototype Antenna #1)**	**2000-02-22**	**2000-02-22**	100%
278	3.10.05.40	US Prototype antenna contract supervision	2000-03-02	2002-05-06	58%
280	**3.10.05.40.10**	**Vertex Prototype antenna PDR**	**2000-06-20**	**2000-06-20**	**100%**
281	**3.10.05.40.15**	**Vertex Prototype antenna CDR**	**2000-11-15**	**2000-11-15**	**100%**
287	**3.10.05.40.22**	**Vertex Prototype Site Assembly Start**	**2001-11-12**	**2001-11-12**	**0%**
291	**3.10.05.40.45**	**Deliver Vertex Prototype Antenna**	**2002-04-23**	**2002-04-23**	**0%**
298	3.10.10	European Antenna Prototype Procurement	1999-03-31	2003-09-19	50%
300	**3.10.10.10**	**Issue prototype antenna CfT**	**1999-04-30**	**1999-04-30**	**100%**
304	**3.10.10.30**	**Sign prototype antenna #2 contract**	**2000-02-21**	**2000-02-21**	**100%**
305	3.10.10.35	Prototype antenna contract supervision	2000-02-21	2002-10-25	54%
307	**3.10.10.35.10**	**EIE Prototype antenna PDR**	**2000-06-22**	**2000-06-22**	**100%**
308	**3.10.10.35.15**	**EIE Prototype antenna CDR**	**2000-11-09**	**2000-11-09**	**100%**



Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

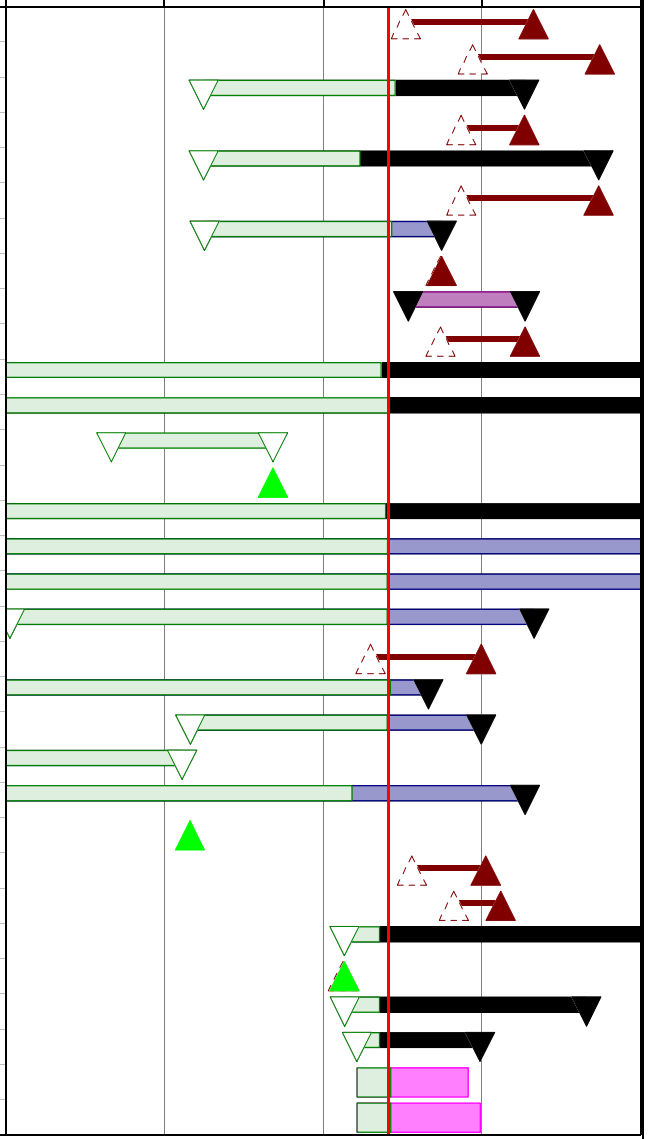
Atacama Large Millimeter Array

ALMA Milestone Progress

(as of 2001-05-30)

Selected Phase 1 Major Milestones and Tasks

Line	WBS (f)	Task	Start	Finish	%done
312	**3.10.10.35.28**	**EIE Starts Installation on Site**	**2002-05-01**	**2002-05-01**	**0%**
317	**3.10.10.35.45**	**Deliver EIE Prototype Antenna**	**2002-09-30**	**2002-09-30**	**0%**
323	3.10.20	Vertex Metrology/Test Equipment	2000-04-01	2002-04-09	78%
350	**3.10.20.40**	**Deliver Vertex Antenna Metrology System**	**2002-04-09**	**2002-04-09**	**0%**
352	3.10.22	EIE Metrology/Test Equipment	2000-04-01	2002-09-27	52%
379	**3.10.22.40**	**Deliver EIE Antenna Metrology System**	**2002-09-27**	**2002-09-27**	**0%**
381	3.10.25	Prototype Vertex Nutator	2000-04-03	2001-10-01	79%
385	**3.10.25.15**	**Deliver Prototype Vertex Nutator**	**2001-10-01**	**2001-10-01**	**0%**
387	3.10.27	Prototype EIE Nutator	2001-07-16	2002-04-11	0%
389	**3.10.27.15**	**Deliver Prototype EIE Nutator**	**2002-04-11**	**2002-04-11**	**0%**
429	**4**	**Front End Subsystem**	1998-06-01	2010-12-31	27%
430	4.05	Front End Management/Subsystem Engineering	1998-06-01	2010-12-31	31%
435	4.05.10	Front End Subsystem Design & Specification	1999-09-01	2000-09-08	100%
439	**4.05.10.20**	**Final Front End Specifications**	**2000-09-08**	**2000-09-08**	**100%**
443	4.10	SIS Mixer Development	1998-06-01	2003-12-17	82%
449	4.10.10	Balanced, sideband separating SIS mixers	1998-06-01	2003-12-17	83%
512	4.10.10.40	Mixers	1998-06-01	2003-12-17	69%
517	4.10.10.40.10	230 GHz	1999-01-11	2002-05-02	75%
563	**4.10.10.40.10.25**	**Deliver prototype 230 GHz Mixer**	**2001-12-31**	**2001-12-31**	**0%**
585	4.10.10.45	Automated Mixer Testing	1998-06-01	2001-08-31	92%
606	4.10.10.53	Integrated IF	2000-03-01	2001-12-31	54%
612	4.10.10.55	Vacuum Windows	1998-06-01	2000-02-11	100%
671	4.20	Antenna Evaluation Front Ends	1998-10-27	2002-04-11	75%
678	**4.20.40**	**Review: Evaluation Front End**	**2000-02-29**	**2000-02-29**	**100%**
684	**4.20.70**	**Deliver Antenna Test Eval Front End #1**	**2002-01-11**	**2002-01-11**	**0%**
686	**4.20.80**	**Deliver Antenna Test Eval Front End #2**	**2002-02-14**	**2002-02-14**	**0%**
687	4.25	Prototype Front Ends	2001-02-19	2004-07-01	8%
688	**4.25.05**	**PDR: Front End Subsystem**	**2001-02-19**	**2001-02-19**	**100%**
689	4.25.10	Front End Engineering Model	2001-02-20	2002-08-30	18%
691	4.25.10.15	Front End Eng. Model Fabrication	2001-03-20	2001-12-28	19%
692	4.25.10.15.05	Cryostat & Front End Chassis Eng. Model	2001-03-20	2001-11-30	30%
693	4.25.10.15.10	Front End Warm Optics Eng. Model	2001-03-20	2001-12-28	27%



Milestones: **bold type**
Summary Tasks: **underline**

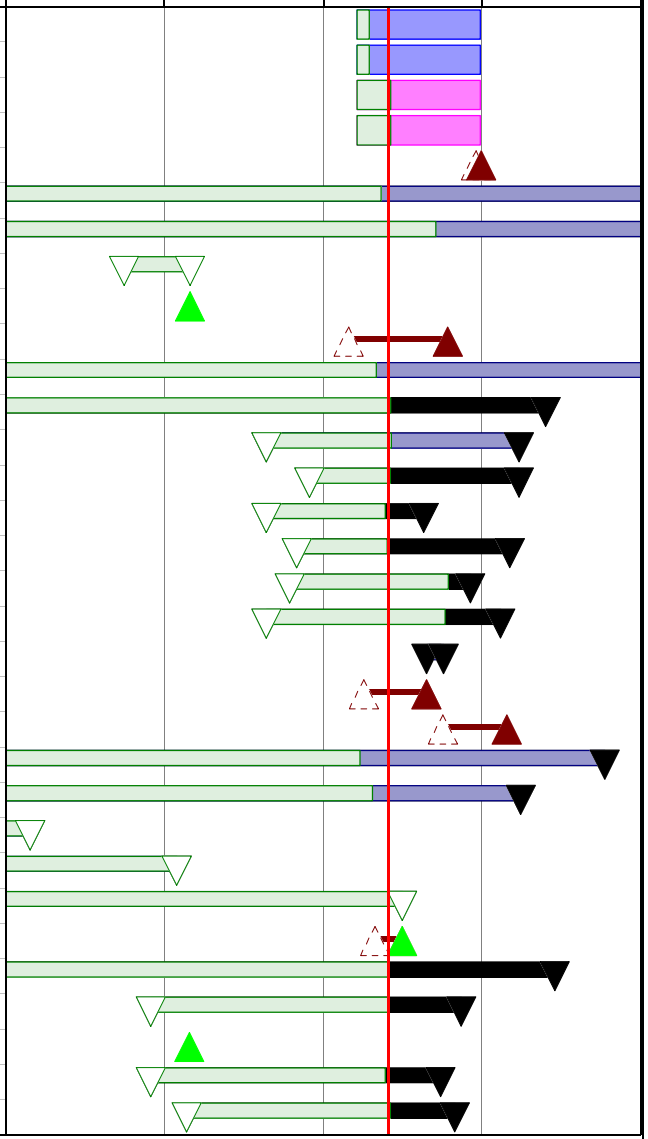
Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

Atacama Large Millimeter Array

ALMA Milestone Progress
(as of 2001-05-30)
Selected Phase 1 Major Milestones and Tasks

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 4:57 PM 2001-06-04

Line	WBS (f)	Task	Start	Finish	%done
695	4.25.10.15.20	Band 3 (89-116GHz) Front End Cartridge Eng. Model	2001-03-20	2001-12-28	10%
696	4.25.10.15.25	Band 6 (211-275 GHz) Front End Cartridge Eng. Model	2001-03-20	2001-12-28	10%
697	4.25.10.15.30	Band 9 (602-720 GHz) Front End Cartridge Eng. Model	2001-03-20	2001-12-28	27%
698	4.25.10.15.35	Band 7 (275-370 GHz) Front End Cartridge Eng. Model	2001-03-20	2001-12-28	27%
703	**4.25.10.25**	**Deliver Front End Eng. Model Components**	**2001-12-31**	**2001-12-31**	**0%**
768	**5**	**Local Oscillator Subsystem**	1998-06-01	2010-12-31	21%
769	5.05	LO Management/Subsystem Engineering	1998-06-01	2010-12-31	21%
773	5.05.15	LO Ref system definition	1999-10-01	2000-02-29	100%
777	**5.05.15.20**	**PDR: LO Reference**	**2000-02-29**	**2000-02-29**	**100%**
778	**5.05.17**	**PDR: LO Subsystem**	**2001-10-15**	**2001-10-15**	**0%**
783	5.10	Prototype LO	1998-06-01	2009-12-24	58%
784	5.10.03	LO Reference US Phase 1	1998-06-01	2002-05-28	76%
788	5.10.05.10	LO Reference Test Int Prototype Modules	2000-08-23	2002-03-28	69%
789	5.10.05.10.10	LO Reference Receiver	2000-12-01	2002-03-28	60%
824	5.10.05.10.15	Two-Laser generator, RF synthesizer	2000-08-23	2001-08-21	65%
835	5.10.05.10.20	Second LO synthesizer	2000-11-01	2002-03-07	40%
870	5.10.05.10.25	Fringe Generator	2000-10-16	2001-12-06	80%
905	5.10.05.10.30	Central LO Reference Generator / Distributor	2000-08-23	2002-02-13	80%
940	5.10.05.15	LO Ref Bench system, integrate and test	2001-08-27	2001-10-05	0%
943	**5.10.05.15.15**	**Deliver LO Ref bench prototype**	**2001-08-27**	**2001-08-27**	**0%**
944	**5.10.05.25**	**Deliver LO Ref field prototype**	**2002-02-28**	**2002-02-28**	**0%**
950	5.10.10	Multiplier Chain LO Prototype	1998-06-01	2002-10-11	62%
969	5.10.10.15	Multiplier R&D	1998-06-01	2002-04-01	74%
974	5.10.10.15.10	55->110 GHz Doubler (Band 9)	1998-06-01	1999-02-26	100%
986	5.10.10.15.15	110->220 GHz Doubler (Band 9)	1998-06-03	2000-01-30	100%
999	5.10.10.15.20	80->240 GHz Tripler (Band 6)	1998-08-03	2001-07-02	100%
1005	**5.10.10.15.20.30**	**Deliver Prototype 80-240GHz tripler**	**2001-07-02**	**2001-07-02**	**100%**
1053	5.10.15	Photonic LO Distribution Prototype	1998-06-01	2002-06-18	71%
1056	5.10.15.48	Photonic Distribution Development	1999-12-01	2001-11-15	71%
1057	**5.10.15.48.05**	**PDR: Photonic Distribution**	**2000-02-28**	**2000-02-28**	**100%**
1058	5.10.15.48.10	Photomixer Modules	1999-12-01	2001-09-28	81%
1068	5.10.15.48.15	Laser Synthesizer and Phase Lock	2000-02-22	2001-10-31	75%



Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

Atacama Large Millimeter Array

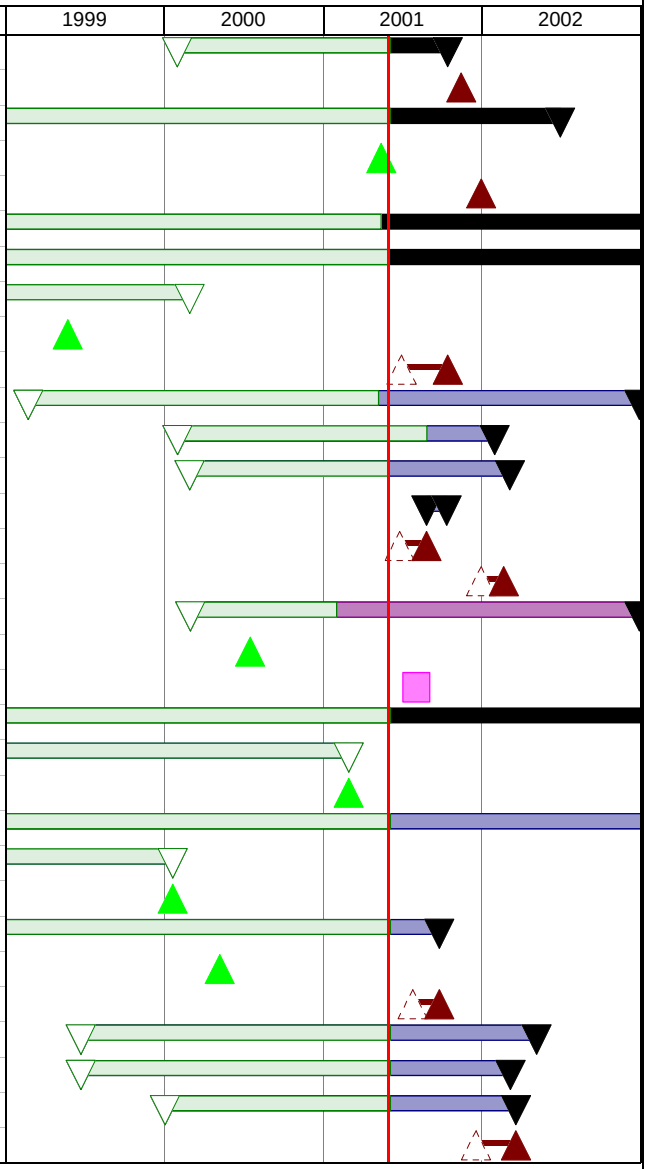
ALMA Milestone Progress

(as of 2001-05-30)

Selected Phase 1 Major Milestones and Tasks

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 4:57 PM 2001-06-04

Line	WBS (f)	Task	Start	Finish	%done
1077	5.10.15.48.20	Correctors for F/O round trip	2000-01-31	2001-10-15	78%
1088	**5.10.15.55**	**Deliver Photonic LO Dist Prototype**	**2001-11-15**	**2001-11-15**	**0%**
1090	5.10.18	Photonic LO Development	1998-06-01	2002-07-01	71%
1092	**5.10.18.10**	**Pump 490 GHz SIS mixer photonically**	**2001-05-15**	**2001-05-15**	**100%**
1094	**5.10.18.20**	**Pump 650 GHz SIS Mixer Photonically**	**2001-12-31**	**2001-12-31**	**0%**
1152	**6**	**Backend Subsystem**	1998-06-01	2010-12-31	23%
1153	6.05	Backend Management/Subsystem Engineering	1998-06-01	2010-12-31	28%
1156	6.05.10	Backend system definition	1998-11-02	2000-02-29	100%
1161	**6.05.10.25**	**Decision: Analog/Digital Transmission**	**1999-05-24**	**1999-05-24**	**100%**
1164	**6.05.16**	**Backend Subsystem PDR**	**2001-10-15**	**2001-10-15**	**0%**
1168	6.10	Prototype Backend Subsystem	1999-02-22	2002-12-30	56%
1170	6.10.10	Test Int IF Down-Converter	2000-02-01	2002-01-31	75%
1176	6.10.15	Test Int Data Transmission System	2000-02-29	2002-03-07	75%
1387	6.10.20	Bench system, integrate and test	2001-08-27	2001-10-12	0%
1390	**6.10.20.15**	**Deliver Backend bench prototype**	**2001-08-27**	**2001-08-27**	**0%**
1392	**6.10.24**	**Deliver Test Int Backend Field Prototype**	**2002-02-21**	**2002-02-21**	**0%**
1396	6.10.45	Prototype Digitizer/Sampler	2000-03-01	2002-12-30	31%
1398	**6.10.45.10**	**Pre-prototype ASIC design to foundry (CMOS)**	**2000-07-17**	**2000-07-17**	**100%**
1403	6.10.45.35	Test Bench qualification tests	2001-07-03	2001-09-03	0%
1421	**7**	**Correlator**	1998-06-01	2010-12-31	27%
1429	7.10	Test Correlator	1998-07-20	2001-03-01	100%
1435	**7.10.30**	**Deliver Test Correlator to Alma Test site**	**2001-03-01**	**2001-03-01**	**100%**
1436	7.15	Baseline Correlator	1998-07-03	2008-04-23	50%
1437	7.15.05	Baseline Correlator Preliminary Design	1998-09-15	2000-01-20	100%
1442	**7.15.05.25**	**PDR: Correlator**	**2000-01-20**	**2000-01-20**	**100%**
1443	7.15.10	Finite Impulse Response Filter Development	1998-07-03	2001-09-25	91%
1454	**7.15.10.40**	**PDR: Finite Impulse Response Filter**	**2000-05-08**	**2000-05-08**	**100%**
1461	**7.15.10.85**	**FIR Filter Performance Report**	**2001-09-25**	**2001-09-25**	**0%**
1462	7.15.15	Custom Board Development	1999-06-23	2002-05-07	67%
1463	7.15.15.05	Station Card	1999-06-23	2002-03-08	65%
1476	7.15.15.10	Correlator Card	2000-01-03	2002-03-21	72%
1485	**7.15.15.10.55**	**Deliver Correlator Card**	**2002-03-21**	**2002-03-21**	**0%**



Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

Atacama Large Millimeter Array

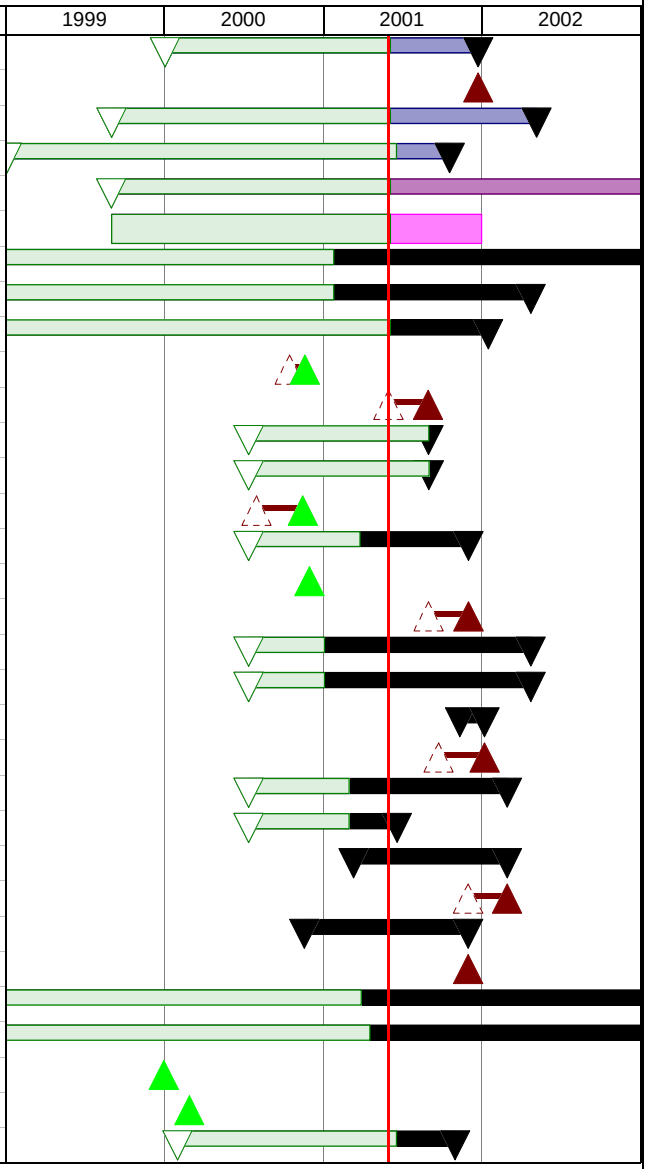
ALMA Milestone Progress

(as of 2001-05-30)

Selected Phase 1 Major Milestones and Tasks

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 4:57 PM 2001-06-04

Line	WBS (f)	Task	Start	Finish	%done
1486	7.15.15.15	Long-Term Accumulator	2000-01-03	2001-12-24	74%
1495	**7.15.15.15.55**	**Deliver Long Term Accumulator**	**2001-12-24**	**2001-12-24**	**0%**
1496	7.15.15.20	System Control Card	1999-09-02	2002-05-07	59%
1506	7.15.20	Correlator Chip Development	1999-01-04	2001-10-19	84%
1546	7.25	Future Correlator	1999-09-01	2010-12-31	8%
1547	7.25.05	Future Correlator Conceptual Design and Specification	1999-09-01	2001-12-31	75%
1555	**8**	**Computing Subsystem**	1998-06-01	2010-12-31	5%
1	8.03	Computing Development (Phase 1)	1998-06-01	2002-04-24	54%
2	8.03.05	Management	1998-06-01	2002-01-16	82%
6	**8.03.05.20**	**US/European Joint Software Meeting**	**2000-11-20**	**2000-11-21**	**100%**
8	**8.03.05.30**	**Deliver Phase 2 Computing Plan**	**2001-08-31**	**2001-08-31**	**0%**
10	8.03.10	Science Software Requirements	2000-07-14	2001-09-01	99%
17	8.03.15	High Level Analysis and Design	2000-07-14	2001-09-02	99%
18	**8.03.15.05**	**Computer Design Concept**	**2000-11-15**	**2000-11-15**	**100%**
37	8.03.25	ALMA Common Software	2000-07-14	2001-12-02	9%
43	**8.03.25.30**	**Kitt Peak ACS test**	**2000-12-01**	**2000-12-01**	**100%**
47	**8.03.25.50**	**Release of ACS for Test Interferometer**	**2001-12-02**	**2001-12-02**	**0%**
48	8.03.30	Control Software	2000-07-14	2002-04-24	33%
49	8.03.30.05	Test Interferometer Control Software	2000-07-14	2002-04-24	33%
204	8.03.30.80	TICS 1.0: Single Dish/Total Power	2001-11-12	2002-01-08	0%
211	**8.03.30.80.35**	**TICS Release 1.0**	**2002-01-08**	**2002-01-08**	**0%**
226	8.03.35	Correlator Software	2000-07-14	2002-03-01	43%
227	8.03.35.05	Test Correlator	2000-07-14	2001-06-20	66%
237	8.03.37	Prototype Correlator	2001-03-12	2002-03-01	0%
244	**8.03.37.35**	**CDR: Prototype Correlator Software**	**2002-03-01**	**2002-03-01**	**0%**
270	8.03.65	Telescope Calibration	2000-11-19	2001-12-01	0%
276	**8.03.65.30**	**Release for Test Interferometer**	**2001-12-01**	**2001-12-01**	**0%**
1556	**9**	**System Engineering & Integration**	1998-06-01	2010-12-31	16%
1559	9.10	System Engineering	1998-06-01	2010-12-31	28%
1561	**9.10.10**	**System Block Diagram for Array**	**1999-12-31**	**1999-12-31**	**100%**
1563	**9.10.20**	**System Design Review**	**2000-02-28**	**2000-02-28**	**100%**
1566	9.12	Test Site Preparation/Outfitting	2000-02-01	2001-11-01	83%



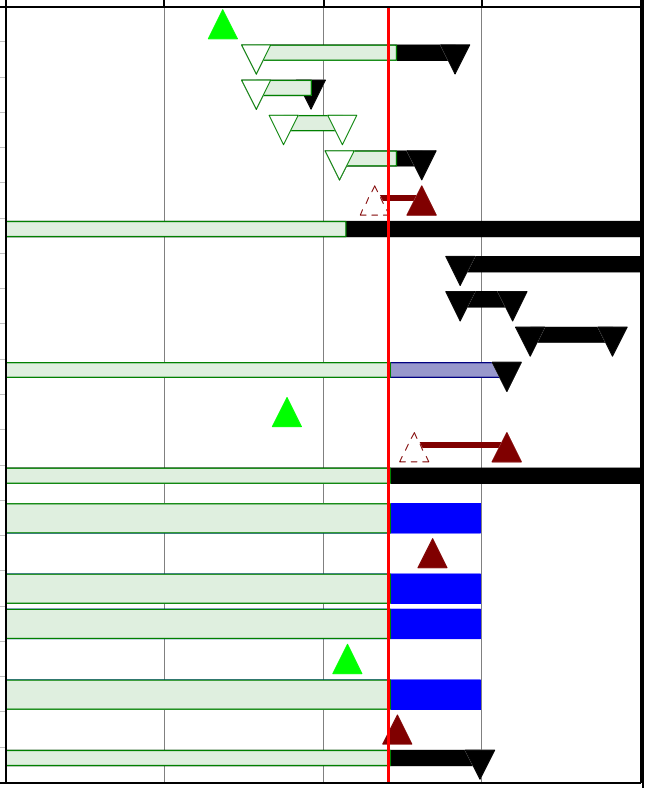
Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

Atacama Large Millimeter Array

ALMA Milestone Progress
(as of 2001-05-30)
Selected Phase 1 Major Milestones and Tasks

Line	WBS (f)	Task	Start	Finish	%done
1568	**9.12.10**	**Design Review: Test Int. Site Preparation**	**2000-05-15**	**2000-05-15**	**100%**
1569	**9.12.15**	**ALMATSF**	2000-07-31	2001-11-01	**81%**
1	9.12.15.05	PROCURE TEST SITE MATERIALS	2000-07-31	2000-12-04	99%
25	9.12.15.20	ANTENNA TEST SITE PREPARATION	2000-10-02	2001-02-14	100%
56	9.12.15.25	Vertex ANTENNA SITE FOUNDATION	2001-02-08	2001-08-16	7%
1571	**9.12.35**	**Test Interferometer Site Complete**	**2001-08-16**	**2001-08-16**	**0%**
1604	**9.15**	**ALMA Prototype Interferometer Evaluation**	**1998-06-01**	**2003-12-16**	11%
7	9.15.20	Vertex Antenna Integration and Testing	2001-11-13	2003-02-07	0%
9	9.15.20.10	Vertex Antenna Installation	2001-11-13	2002-03-13	0%
39	9.15.20.30	Vertex Antenna Systems Installation and Testing	2002-04-23	2002-10-29	0%
1605	9.20	Holography System	1998-09-01	2002-02-28	53%
1610	**9.20.25**	**CDR: Holography System**	**2000-10-10**	**2000-10-10**	**100%**
1621	**9.20.30**	**Deliver Holography System**	**2002-02-28**	**2002-02-28**	**0%**
1631	**10**	**Science**	1998-06-01	2009-12-31	61%
1632	10.05	Scientific Requirements	1998-06-01	2001-12-28	84%
1633	**10.07**	**ASAC Face-to-Face Meeting**	**2001-09-10**	**2001-09-10**	**0%**
1634	10.10	Site Monitoring and Characterization	1998-06-01	2001-12-28	84%
1635	10.15	Array Design and Operation	1998-06-01	2001-12-28	84%
1636	**10.17**	**PDR: ALMA Array Layout**	**2001-02-26**	**2001-02-26**	**100%**
1638	10.20	Calibration	1998-06-01	2001-12-28	84%
1639	**10.22**	**PDR: Calibration**	**2001-06-21**	**2001-06-21**	**0%**
1640	10.25	Imaging	1998-06-01	2001-12-28	84%



Milestones: **bold type**
Summary Tasks: **underline**

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn