MILLIMETER ARRAY/ALMA-US
DESIGN AND DEVELOPMENT

MONTHLY REPORT
MONTH END JANUARY 2001

1 Executive Summary

During the month of January, much effort has been devoted to preparing for several major events scheduled for February. These include the meeting of the Millimeter Array Oversight Committee scheduled for 15-16 February in Washington, the Front End PDR scheduled for 19-20 February in Tucson, the ASAC meeting scheduled for 23-24 February in Florence and the Configuration PDR scheduled for 25-26 February in Grenoble. Each of these meetings represent major milestones or are expected to reach significant decisions regarding the scope and management of ALMA.

Of particular note is the ASAC meeting which will develop a recommended priority for the possible enhancements to the baseline scope made possible by the expected addition of Japan as a third equal partner in ALMA.

The project continues to have confidence that prototype antenna under development by Vertex will meet all of the specifications. The scheduled delivery date is under review as Vertex begins to investigate means of recovering approximately two months of additional development time. Several options are being considered that could shorten the fabrication time.

Progress continues on the development of the front end, local oscillator, backend and correlator subsystems. A significant advance was the demonstration of an integrated 4-12GHz preamplifier with an SIS mixer for 211-275GHz band. Using a newly available 200μ gate device, the achieved system noise of 60K is 10K better than previously achieved while providing 10dB additional gain.

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 58.4.

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.

In January, only one major milestone was scheduled for completion. This was the Preliminary Design Review for the Site Development Plan. This review has been rescheduled for October 2001 to provide sufficient time to study a new proposed OSF site closer to the array site.

3 Meetings And Memos

3.1 Meetings Held During January 2001

ALMA Configuration Group Teleconference - January 4, 23
JRDG Teleconference - January 4, 31
Polarization Teleconference - January 4
ALMA DH Meeting - January 15, 22
ALMA Joint DH/TL Teleconference - January 5, 29
ALMA Optics Teleconference - January 12
ASAC Teleconference - January 19
ALMA CV Site Teleconference - January 25
ALG Meeting - January 15-16 (Tokyo, Japan)
ALMA/NSF Meeting - weekly teleconferences
ALMA Lo/Rx Meeting - weekly teleconferences
ALMA Imaging and Calibration Meeting - weekly telecons
ALMA Executive Committee Meeting - weekly teleconferences
ALMA Control Software - weekly teleconferences
ALMA Joint Software Management - weekly teleconferences

ALMA Joint Software Workers - monthly teleconferences
ALMA SSR - monthly teleconferences

3.2 Planned Meetings in February 2001

Future Correlator Meeting - February 6-7
ALMA DH Meeting (teleconference) - February 5, 12
ALMA DH Face-to-Face Meeting - February 14 (Washington, DC)
MMAOC Meeting - February 15-16 (Washington, DC)
ALMA Front End PDR - February 19-20 (Tucson, AZ)
ASAC Face-to-Face Meeting - February 23-24 (Florence, Italy)
ACC Teleconference - February 22
ALMA Configuration PDR - February 26-27 (Grenoble)
ALMA/NSF Meeting - weekly teleconferences
ALMA Lo/Rx Meeting - weekly teleconferences
ALMA Imaging and Calibration Meeting - weekly teleconferences
ALMA Executive Committee Meeting - weekly teleconferences
ALMA Control Software - weekly teleconferences
ALMA Joint Software Management - weekly teleconferences
ALMA Joint Software Workers - monthly teleconferences
ALMA SSR - monthly teleconferences

3.3 ALMA Technical Memos Distributed in January 2001

No	Title	Authors
343	Waveguide Quadrature Hybrids for ALMA Receivers	S. Srikanth and A. R. Kerr
344	Mixer Preamp to Receiver Interface Considerations for ALMA Band 6	A. R. Kerr
345	Phase Fluctuation at the ALMA Site and the Height of the Turbulent Layer	Yasmin Robson et al.
346	Spatial Distribution of the Near Surface Soil Resistivity in the Cerro Chason Science Preserve	Seiichi Sakamoto and Tomohiko Sekiguchi

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

Vertex delivered a comprehensive Safety Plan which is now under review both within the ALMA project and by Jody Bolyard, head of safety for NRAO.

Additional soil test data for the ALMA antenna foundations taken at the VLA site have been received. These data were required to finalize the design of the foundations.

The Vertex and EIE foundation designs are under review in preparation for the procurement of the antenna foundations. The designs will require conversion from Eurocode standards to US standards so that a larger number of local contractors will be able to bid on the job.

Vertex continues to look good as far as meeting specifications is concerned, but holding the schedule is becoming difficult. They have notified us of a potential 2-month slip in the antenna delivery date and we are working with them to find ways of recovering this slip.

4.2 Front End

This month has been largely occupied with preparations for both the ALMA receiver PDR in Tucson and the MMAOC Meeting in Washington.

Work has progressed on the Evaluation Receivers and also the orthomode transducers for the 3mm band to be used on both the Evaluation Receivers and the final ALMA receivers. The optics design for the 10 bands of the ALMA receivers has been finalized and a draft report issued.

Receiver Components

The requirements for amplification of IF signals from SIS mixers, either by use of an integrated preamplifier, a narrower-band isolator followed by a cold amplifier, or a balanced amplifier, were evaluated in the context of requirements for further amplification either within or without the dewar. A memo on this subject was written and distributed to the JRDG as ALMA Memo 344, “Mixer-Preamp to Receiver Interface Considerations for ALMA Band 6”.

Tests of the integrated 4-12 GHz preamplifier with a Band 6 single-ended SIS mixer were conducted, using newly available 200-micron-gate devices that have improved noise performance at low frequencies over devices previously used. Compared to the 300-micron-gate devices previously used, the receiver noise was reduced by 10K and the gain was increased by 10 dB, so that no further amplification inside the dewar was required. The noise is about 60K over the entire 4-12 GHz IF range, and over the entire 211-275 GHz Band 6 RF range. The power dissipated was also reduced, from about 9 mW to 8 mW, reducing the heat load on the 4K stage.

Design work continued on the configuration of an interface between a balanced Band 6 SIS mixer (for which we already have working MMIC chips) and an IF preamplifier. Calculations show that good performance can be expected. Details of the biasing scheme and mechanical interface are being worked out. After successful demonstration of this interface, the design of the interface for the Band 6 sideband-separating, balanced mixer should be a simple extension.

Design work continued on the alternative approach to MMIC chips for making balanced or sideband-separating SIS mixers. ALMA Memo 343, "Waveguide Quadrature Hybrids for ALMA Receivers" was written on this subject. We intend to fabricate and test such a configuration which may have some advantages in a production environment.

Work is continuing on improved optics for the test system, including matching layers for windows, lenses, and IR filters. Some experiments in machining the plastic materials are in progress in the shop, and some materials have been characterized. Most of the measurements have been made with an HP 85106 vector network analyzer at 100 GHz. This instrument has experienced some malfunctions and repair work is underway.

Work continued on making operational the second closed-cycle test dewar for SIS mixers, named JT1. Much work remains to be done on this system to equip it for routine use, but the cryogenic performance has already been improved. New heaters have been installed and additional oil filters installed in the JT refrigerator supply lines to prevent anomalous warm-ups.

A new noise-measuring system using an Agilent E4418B power meter is being developed; this will enable SIS mixer testing to proceed faster than with the old HP436 power meter. An instability in the noise measurement test setup was finally traced to voltage fluctuations on the AC power mains. This was reduced satisfactorily by placing the LO source power supply on an uninterruptible power supply.

Considerable effort was spent on preparing materials for the front end PDR to be held in mid-February.

4.3 Local Oscillator System

Tests were performed on a breadboard version of the 100-120 GHz LO driver needed for ALMA Band 9, using the available 100-112 GHz MMIC power amplifiers built from TRW chips in collaboration with JPL. This power chain will also directly drive the Band 3 mixers, which are planned to need only a tuning range of 101-104 GHz. Design work was carried out on a 75-110 GHz conventional mixer needed in the phase lock loop for several bands; it is planned to use University of Virginia's planar diode arrays. Although commercial devices exist for this band, they are expensive and it appears we can make our own much more cheaply, possibly integrating several components of the LO driver and phase lock loop in one block. This conventional mixer in a sideband-separating configuration (using the waveguide hybrids developed for SIS mixer use) may also be used in the ALMA Band 3 front ends, following an HFET amplifier.

The design of the prototype 80-240 GHz frequency tripler was completed. An order was placed for the epitaxial material and mask sets to be used in this device. Some of the

required formal drawings for the tripler block were sent to the CDL shop for fabrication; completion of the drawings is expected by mid-February. The target for delivering prototypes to Tucson for use in the test receivers is May 2001. A calculation of the expected power output from this tripler with 50 mW of input power was performed; we expect more than 10 mW output at the center of the band, and more than 1 mW over most of the required LO band; this is much more than the 50-100 microwatts needed for a Band 6 SIS mixer. Further calculations resulted in a prediction that, with some changes to the input and output circuitry, the power output could be made much flatter as a function of frequency; these discoveries will be used in future designs.

The phase noise test equipment in Charlottesville was boxed and shipped to Tucson for a series of tests to be conducted in early February. A fixed-frequency low phase noise reference generator built in Socorro will be used as well. The purpose of the tests will be to measure the performance of a breadboard prototype of the entire LO chain, including photonic reference signal transmitted over a fiber optic cable. This will be the first combined test of the baseline LO system.

4.4 Backend Subsystem

Revised the parts list and cost estimate for the prototype down-converter. Careful setup and use of precision calibration set produced reliable 8510C VNA tests. Tested all isolators and the better pairs look good. Tests of temperature sensitivity are now planned.

The bandpass filters for 4-12 GHz, 4-8 GHz and 8-12 GHz have very good frequency response, fair return loss and phase linearity, and very good temperature stability of amplitude and phase.

Started testing one of the 2x2 matrix switches.

Began programming LabView for mixer testing with a frequency synthesizer, a sweeper and a spectrum analyzer. Significant progress has been achieved with the sigma-delta digitizer for total power.

4.5 Correlator

Work on refining the software and final modifications to the hardware of the test correlator was performed. The correlator is now expected to be shipped to Socorro in mid-February.

Intensive simulation of the ALMA-1 custom correlator chip has been completed. A final review of the functional design by examination of the schematic diagrams was initiated. We anticipate being ready to authorize fabrication of prototypes in February.

Assembled prototypes of the Station Card and Long Term Accumulator Card were received, and testing began.

The construction of the test fixture for the Station Card and FIR Filter Card was about 75% complete by the end of January. It is expected that this will be completed in mid-February, and that tests using both prototypes will begin then.

A test fixture is being designed for testing correlator chips; the design is essentially complete, and waiting only for final chip design approval before layout begins. Final design and layout of the correlator card is also waiting such approval.

4.6 Computing

Completed a review of a software group document template, C, and C++ standards. Produced a first draft software analysis from ALMA SSR committee use cases in preparation for integration into first draft in February. This includes use cases, sequence diagrams, state diagrams, packages and architecture.

The design of the Control System Executive Program for the Test Interferometer is progressing on schedule. In addition, a similar specification for software analysis including exec, session control and resource manager is being written. The Test Interferometer software Executive Program consists of:

System Executive
Resource Management
Antenna Generation and control
Sub-Array Communications and Control
Session Control
User Command Interface
Data Collection System
Control and Configuration Database

The newly implemented bin switching in the test correlator control software was tested. This enables one to observe multiple sources with 48-ms switching times. Several bugs were identified and fixed prior to shipping the test correlator in February.

The "ACS and AMS Kitt Peak 2000 Test" report was revised and distributed.

4.7 Systems Engineering

Version 4.0 of the ALMA Construction Project Book is nearing completion. Version 4.0, which will be released early in February, will be the first version modified under the configuration control plan.

Very good progress was made on ALMA TI planning. We made a significant revision to the work plan, which included a further honing of the task timescales and an assignment of resources to major task groups. To further firm-up this plan the Division Heads will discuss their plans for resource allocation to the TI.

Design work continued on the secondary mirror nutator, including analysis of motor performance. Assembly and testing of nutator demonstrator is progressing on schedule. Documentation for the upcoming progress review was assembled.

4.8 Imaging and Calibration

ALMA was represented at the AAS meeting in San Diego with a booth in the NRAO complex. New brochures have been produced in two flavors: 1) an easy to understand trifold, suitable for non-astronomers, and 2) a bifold remake of the previous brochure, suitable for astronomers.

The Imaging and Calibration group discussed items from the AAS and URSI meetings. These include a calibration concept proposed by Guilloteau, in which he recommends construction of a transparent vane calibration load for evaluation.

A face to face ASAC meeting will be held 23-24 Feb in Florence. The ASAC invited Robert Lucas, head of the SSR team, to make a presentation at that meeting and join the ASAC mailing list.

Plans for the Configuration PDR, to be held on 26-7 February in Grenoble, continue. The external reviewers will be Lee Mundy, from U. Md. and Eric Anterrieu of the Signal & Image Processing Team at CERFACS in Toulouse. Other members of the project which have requirements which will impact the configuration review are invited to apprise me of them so that these may be incorporated into the review.

A teleconference was held between imaging and calibration, engineering, and interested scientists on ALMA polarimetry specifications and requirements.

An analysis system for optical pointing data with the optical pointing telescope was developed.

Stephane Guilloteau's suggestion (in a draft ALMA memo) that the partially-transparent vane might be a viable amplitude calibration system for ALMA is under investigation.

Site characterization data web pages were updated. We also updated the radiosonde data page with flights through 2000 December 17. We had a quick look at the site characterization data for the dates identified by S. Myers as problematic for the CBI. No obvious signatures other than (relatively) high optical depth ($0.2 < \tau_{225} < 0.3$) and clouds during the daytime surveillance images, both of which also occur at other times not identified by Myers.

MILLIMETER ARRAY/ALMA-US

PROJECT STAFFING

MONTH END JANUARY 2001

WBS Task Name	Number Of Persons Participating in Activity*	Full-time Equivalent Employees
Administration	11	6.9
Site Development	1	0.0
Antennas	5	3.0
Front-End	20	16.3
Local Oscillator	11	8.8
IF and Fiber Optics	7	6.0
Correlator	5	4.0
Computing	9	8.5
System Integration	5	4.5
Calibration	2	2.0
TOTAL:	76.0	60.0

* 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

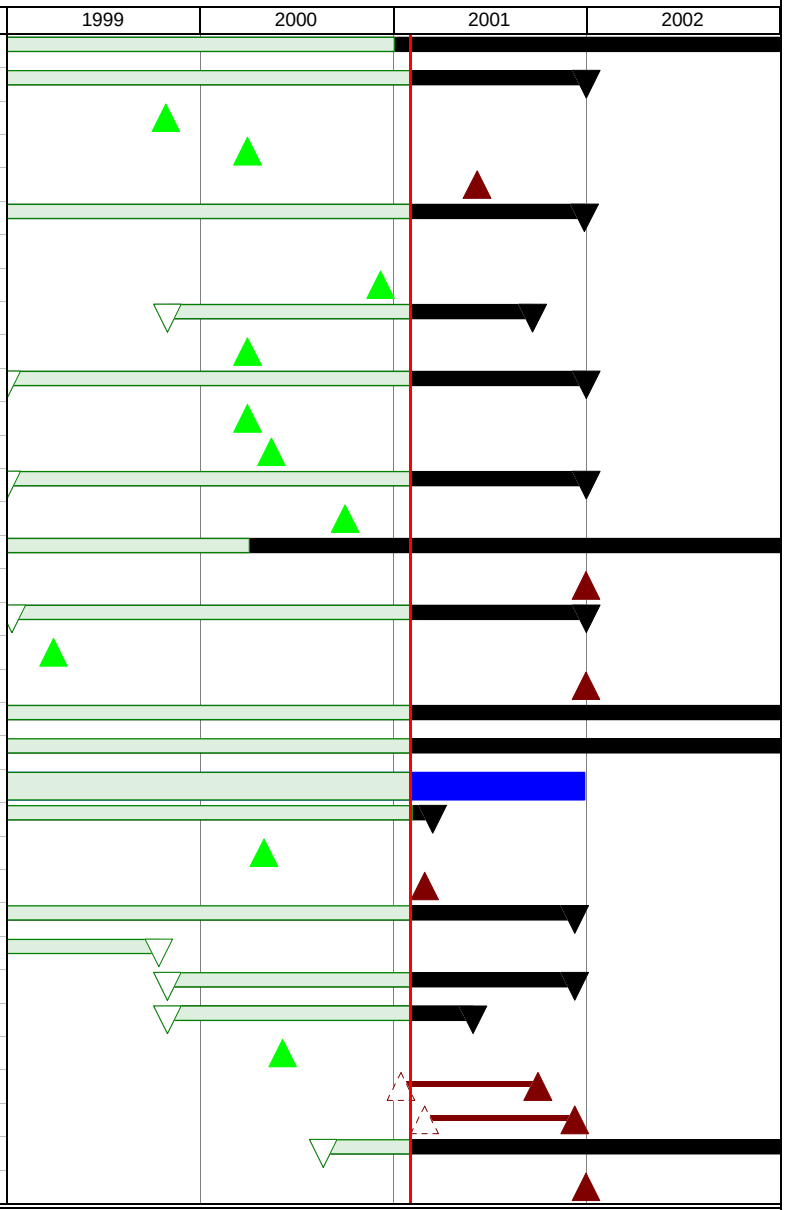
ALMA Milestone Progress

(as of 2001-01-30)

Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 11:08 AM 2001-02-05

Line	WBS (f)	Task	Start	Finish	%done
1	**1**	**Management/Administration**	1998-06-01	2010-12-31	45%
2	1.05	Phase 1 Management	1998-06-01	2001-12-31	75%
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	74%
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	65%
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	66%
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	72%
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	22%
79	**1.20.10**	**CONICYT Use Permissions**	**2001-12-31**	**2001-12-31**	**0%**
86	1.25	Partnerships and Agreements	1999-01-11	2001-12-31	64%
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%**
96	**2**	**Site Development**	1998-06-01	2010-12-31	24%
97	2.05	Site Development Management	1998-06-01	2006-01-19	31%
98	2.05.03	Site Development Management Phase 1	1998-06-01	2001-12-28	75%
102	2.07	Site Development Requirements	1998-06-01	2001-03-16	96%
104	**2.07.10**	**Deliver Initial Operations Plan**	**2000-05-01**	**2000-05-01**	**100%**
105	**2.07.15**	**Deliver Revised Operations Plan**	**2001-03-01**	**2001-03-01**	**0%**
106	2.10	Development Plans	1998-06-01	2001-12-10	88%
107	2.10.05	Prepare Preliminary Development Plan	1998-06-01	1999-10-15	100%
116	2.10.10	Estimate Development Costs	1999-11-01	2001-12-10	67%
117	2.10.10.05	Prepare Initial Plan	1999-11-01	2001-05-31	82%
125	**2.10.10.05.38**	**Deliver Initial Site Development Plan**	**2000-06-05**	**2000-06-05**	**100%**
135	**2.10.10.15**	**PDR: Site Development Plan**	**2001-10-01**	**2001-10-01**	**0%**
137	**2.10.10.25**	**Deliver revised development Plan**	**2001-12-10**	**2001-12-10**	**0%**
138	2.15	Site Legal Issues	2000-08-21	2010-12-31	2%
139	**2.15.05**	**(CONICYT Use Permissions Delivered from WBS 1)**	**2001-12-31**	**2001-12-31**	**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

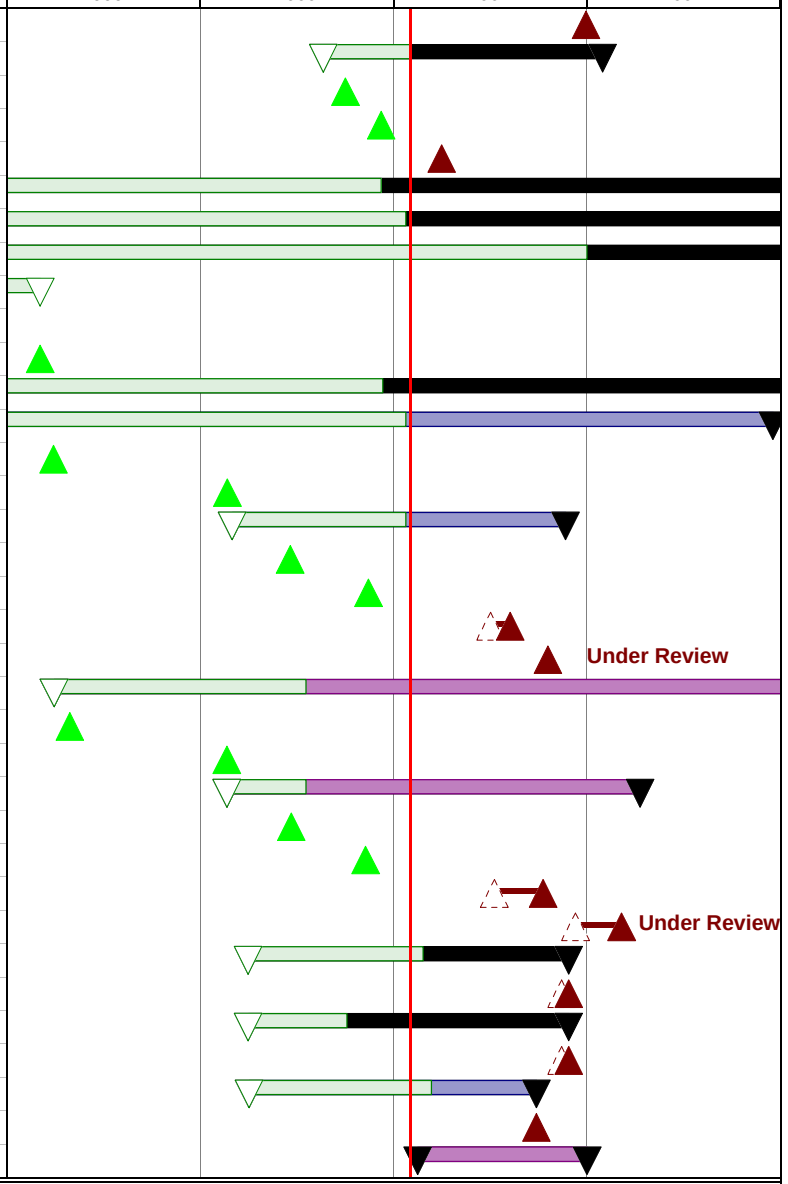
ALMA Milestone Progress

(as of 2001-01-30)

Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 11:08 AM 2001-02-05

Line	WBS (f)	Task	Start	Finish	%done
140	**2.15.10**	**(Access to OSF Land Delivered from WBS 1)**	**2001-12-31**	**2001-12-31**	**0%**
141	2.15.15	Process Environmental Documents (EIA)	2000-08-21	2002-01-31	22%
143	**2.15.15.07**	**EIA Started**	**2000-10-02**	**2000-10-02**	**100%**
144	**2.15.15.10**	**Deliver Initial EIA**	**2000-12-09**	**2000-12-09**	**100%**
146	**2.15.15.20**	**Submit EIA Documents**	**2001-04-02**	**2001-04-02**	**0%**
252	**3**	**Antenna Subsystem**	1998-06-01	2010-12-31	20%
253	3.05	Antenna Management/Subsystem Engineering	1998-06-01	2010-12-31	19%
256	3.05.10	Antenna Subsystem Engineering	1998-06-01	2010-07-01	16%
257	3.05.10.05	Antenna Subsystem Design & Specification	1998-06-01	1999-03-05	100%
263	**3.05.10.05.30**	**Antenna PDR**	**1998-07-28**	**1998-07-28**	**100%**
265	**3.05.10.05.40**	**CDR: Antenna RFP/CfT**	**1999-03-05**	**1999-03-05**	**100%**
267	3.10	Prototype Antennas	1998-09-22	2003-04-11	41%
268	3.10.05	U.S. Prototype Antenna	1998-09-22	2002-12-19	41%
271	**3.10.05.15**	**Issue Prototype Antenna RFP**	**1999-03-30**	**1999-03-30**	**100%**
275	**3.10.05.35**	**Sign Contract (Prototype Antenna #1)**	**2000-02-22**	**2000-02-22**	100%
276	3.10.05.40	US Prototype antenna contract supervision	2000-03-02	2001-11-22	54%
278	**3.10.05.40.10**	**Vertex Prototype antenna PDR**	**2000-06-20**	**2000-06-20**	**100%**
279	**3.10.05.40.15**	**Vertex Prototype antenna CDR**	**2000-11-15**	**2000-11-15**	**100%**
285	**3.10.05.40.22**	**Vertex Prototype Site Assembly Start**	**2001-08-10**	**2001-08-10**	**0%**
289	**3.10.05.40.45**	**Deliver Vertex Prototype Antenna**	**2001-10-20**	**2001-10-20**	**0%**
296	3.10.10	European Antenna Prototype Procurement	1999-03-31	2003-04-11	26%
298	**3.10.10.10**	**Issue prototype antenna CfT**	**1999-04-30**	**1999-04-30**	**100%**
302	**3.10.10.30**	**Sign prototype antenna #2 contract**	**2000-02-21**	**2000-02-21**	**100%**
303	3.10.10.35	Prototype antenna contract supervision	2000-02-21	2002-04-12	22%
305	**3.10.10.35.10**	**EIE Prototype antenna PDR**	**2000-06-22**	**2000-06-22**	**100%**
306	**3.10.10.35.15**	**EIE Prototype antenna CDR**	**2000-11-09**	**2000-11-09**	**100%**
310	**3.10.10.35.28**	**EIE Starts Installation on Site**	**2001-10-11**	**2001-10-11**	**0%**
316	**3.10.10.35.45**	**Deliver EIE Prototype Antenna**	**2002-03-08**	**2002-03-08**	**0%**
322	3.10.20	Vertex Metrology/Test Equipment	2000-04-01	2001-11-28	61%
348	**3.10.20.40**	**Deliver Vertex Antenna Metrology System**	**2001-11-28**	**2001-11-28**	**0%**
350	3.10.22	EIE Metrology/Test Equipment	2000-04-01	2001-11-28	34%
376	**3.10.22.40**	**Deliver EIE Antenna Metrology System**	**2001-11-28**	**2001-11-28**	**0%**
378	3.10.25	Prototype Vertex Nutator	2000-04-03	2001-09-28	63%
382	**3.10.25.15**	**Deliver Prototype Vertex Nutator**	**2001-09-28**	**2001-09-28**	**0%**
384	3.10.27	Prototype EIE Nutator	2001-02-16	2002-01-02	0%



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

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

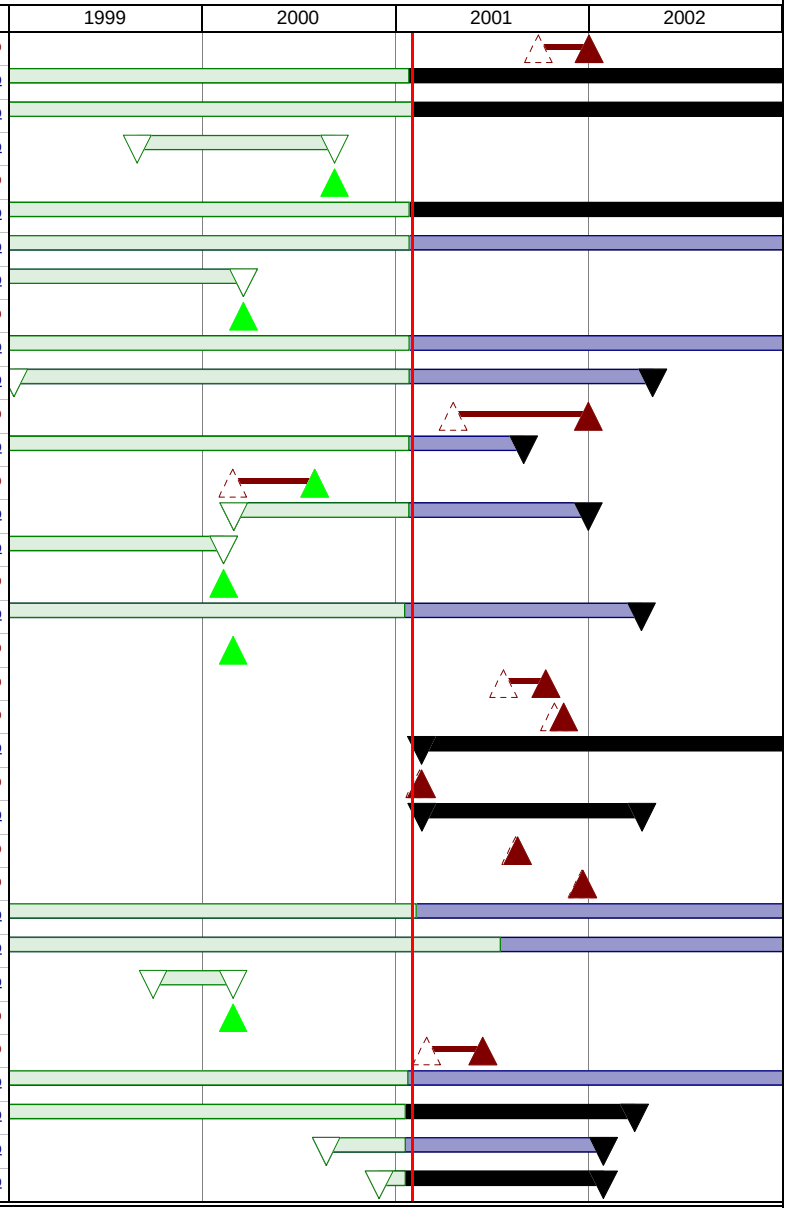
Atacama Large Millimeter Array

ALMA Milestone Progress

(as of 2001-01-30)

Phase 1 Major Milestones and Tasks selected

Line	WBS (f)	Task	Start	Finish	%done
386	**3.10.27.15**	**Deliver Prototype EIE Nutator**	**2002-01-02**	**2002-01-02**	**0%**
422	**4**	**Front End Subsystem**	1998-06-01	2010-12-31	24%
423	4.05	Front End Management/Subsystem Engineering	1998-06-01	2010-12-31	28%
428	4.05.10	Front End Subsystem Design & Specification	1999-09-01	2000-09-08	100%
432	**4.05.10.20**	**Final Front End Specifications**	**2000-09-08**	**2000-09-08**	**100%**
436	4.10	SIS Mixer Development	1998-06-01	2003-12-17	73%
442	4.10.10	Balanced, sideband separating SIS mixers	1998-06-01	2003-12-17	74%
443	4.10.10.05	Specifications	1998-06-01	2000-03-20	100%
445	**4.10.10.05.10**	**Review: SIS Mixer**	**2000-03-20**	**2000-03-20**	**100%**
505	4.10.10.40	Mixers	1998-06-01	2003-12-17	61%
510	4.10.10.40.10	230 GHz	1999-01-11	2002-05-02	67%
558	**4.10.10.40.10.25**	**Deliver prototype 230 GHz Mixer**	**2001-12-31**	**2001-12-31**	**0%**
580	4.10.10.45	Automated Mixer Testing	1998-06-01	2001-08-31	82%
585	**4.10.10.45.25**	**Complete automated mixer characterization**	**2000-08-01**	**2000-08-01**	**100%**
601	4.10.10.53	Integrated IF	2000-03-01	2001-12-31	29%
607	4.10.10.55	Vacuum Windows	1998-06-01	2000-02-11	100%
617	**4.10.10.55.50**	**Complete 86 GHz Vac. Window Development**	**2000-02-11**	**2000-02-11**	**100%**
666	4.20	Antenna Evaluation Front Ends	1998-10-27	2002-04-11	74%
674	**4.20.40**	**Review: Evaluation Front End**	**2000-02-29**	**2000-02-29**	**100%**
680	**4.20.70**	**Deliver Antenna Test Eval Front End #1**	**2001-10-12**	**2001-10-12**	**0%**
682	**4.20.80**	**Deliver Antenna Test Eval Front End #2**	**2001-11-15**	**2001-11-15**	**0%**
683	4.25	Prototype Front Ends	2001-02-19	2004-03-04	0%
684	**4.25.05**	**PDR: Front End Subsystem**	**2001-02-19**	**2001-02-19**	**0%**
685	4.25.10	Front End Engineering Model	2001-02-20	2002-04-12	0%
698	**4.25.10.20**	**Front End Eng. Model Progress Review 2**	**2001-08-20**	**2001-08-20**	**0%**
699	**4.25.10.25**	**Deliver Front End Eng. Model Components**	**2001-12-21**	**2001-12-21**	**0%**
764	**5**	**Local Oscillator Subsystem**	1998-06-01	2010-12-31	18%
765	5.05	LO Management/Subsystem Engineering	1998-06-01	2010-12-31	20%
769	5.05.15	LO Ref system definition	1999-10-01	2000-02-29	100%
773	**5.05.15.20**	**PDR: LO Reference**	**2000-02-29**	**2000-02-29**	**100%**
774	**5.05.17**	**PDR: LO Subsystem**	**2001-06-15**	**2001-06-15**	**0%**
779	5.10	Prototype LO	1998-06-01	2009-12-24	49%
780	5.10.03	LO Reference US Phase 1	1998-06-01	2002-03-29	58%
784	5.10.05.10	LO Reference Test Int Prototype Modules	2000-08-23	2002-01-29	34%
785	5.10.05.10.10	FO Receiver, LO Reference	2000-12-01	2002-01-29	17%



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

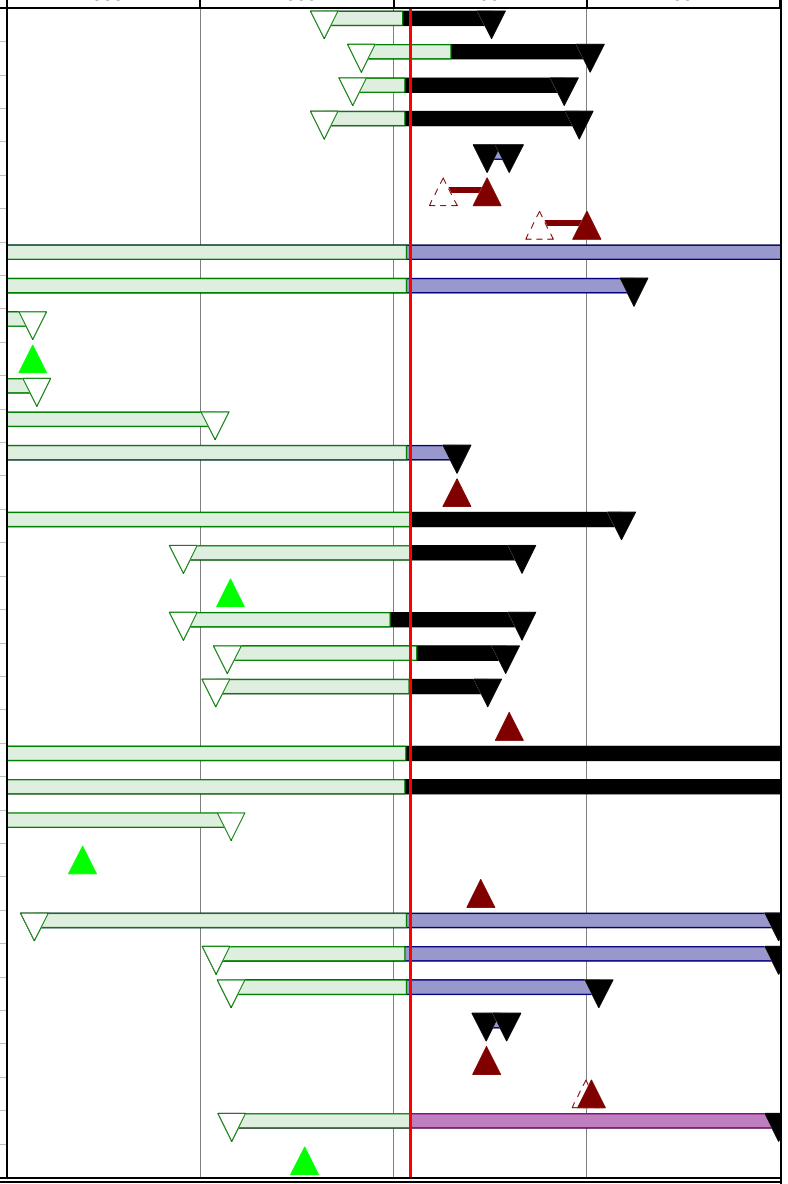
Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

Atacama Large Millimeter Array

ALMA Milestone Progress
(as of 2001-01-30)
Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress
Printed: 11:08 AM 2001-02-05

Line	WBS (f)	Task	Start	Finish	%done
820	5.10.05.10.15	Two-Laser generator, RF synthesizer	2000-08-23	2001-07-05	32%
831	5.10.05.10.20	Second LO synthesizer	2000-11-01	2002-01-08	19%
866	5.10.05.10.25	Fringe Generator	2000-10-16	2001-11-20	29%
901	5.10.05.10.30	Central LO Reference Generator / FO Xmtr	2000-08-23	2001-12-18	54%
936	5.10.05.15	LO Ref Bench system, integrate and test	2001-06-27	2001-08-08	0%
939	**5.10.05.15.15**	**Deliver LO Ref bench prototype**	**2001-06-27**	**2001-06-27**	**0%**
940	**5.10.05.25**	**Deliver LO Ref field prototype**	**2002-01-01**	**2002-01-01**	**0%**
946	5.10.10	Multiplier Chain LO Prototype	1998-06-01	2003-07-03	58%
965	5.10.10.15	Multiplier R&D	1998-06-01	2002-04-01	69%
966	5.10.10.15.05	Prototype multiplier development	1998-06-01	1999-02-19	100%
969	**5.10.10.15.05.15**	**PDR: Multiplier Chain LO**	**1999-02-19**	**1999-02-19**	**100%**
970	5.10.10.15.10	55->110 GHz Doubler (Band 9)	1998-06-01	1999-02-26	100%
982	5.10.10.15.15	110->220 GHz Doubler (Band 9)	1998-06-03	2000-01-30	100%
995	5.10.10.15.20	80->240 GHz Tripler (Band 6)	1998-08-03	2001-05-01	93%
1001	**5.10.10.15.20.30**	**Deliver Prototype 80-240GHz tripler**	**2001-05-01**	**2001-05-01**	**0%**
1049	5.10.15	Photonic LO Distribution Prototype	1998-06-01	2002-03-08	63%
1052	5.10.15.48	Photonic Distribution Development	1999-12-01	2001-09-01	61%
1053	**5.10.15.48.05**	**PDR: Photonic Distribution**	**2000-02-28**	**2000-02-28**	**100%**
1054	5.10.15.48.10	Photomixer Modules	1999-12-01	2001-09-01	79%
1064	5.10.15.48.15	Laser Synthesizer and Phase Lock	2000-02-22	2001-08-01	58%
1073	5.10.15.48.20	Correctors for F/O round trip	2000-01-31	2001-06-28	72%
1084	**5.10.15.55**	**Deliver Photonic LO Dist Prototype**	**2001-08-08**	**2001-08-08**	**0%**
1142	**6**	**Backend Subsystem**	1998-06-01	2010-12-31	19%
1143	6.05	Backend Management/Subsystem Engineering	1998-06-01	2010-12-31	25%
1146	6.05.10	Backend system definition	1998-11-02	2000-02-29	100%
1151	**6.05.10.25**	**Decision: Analog/Digital Transmission**	**1999-05-24**	**1999-05-24**	**100%**
1154	**6.05.16**	**Backend Subsystem PDR**	**2001-06-15**	**2001-06-15**	**0%**
1158	6.10	Prototype Backend Subsystem	1999-02-22	2002-12-30	41%
1160	6.10.10	Test Int IF Down-Converter	2000-02-01	2002-12-30	45%
1167	6.10.15	Test Int Data Transmission System	2000-02-29	2002-01-24	44%
1378	6.10.20	Bench system, integrate and test	2001-06-25	2001-08-03	0%
1381	**6.10.20.15**	**Deliver Backend bench prototype**	**2001-06-26**	**2001-06-26**	**0%**
1383	**6.10.24**	**Deliver Test Int Backend Field Prototype**	**2002-01-10**	**2002-01-10**	**0%**
1386	6.10.45	Prototype Digitizer/Sampler	2000-03-01	2002-12-30	31%
1388	**6.10.45.10**	**Pre-prototype ASIC design to foundry (CMOS)**	**2000-07-17**	**2000-07-17**	**100%**



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

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
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Milestone
Progress
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Atacama Large Millimeter Array

ALMA Milestone Progress
(as of 2001-01-30)
Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress
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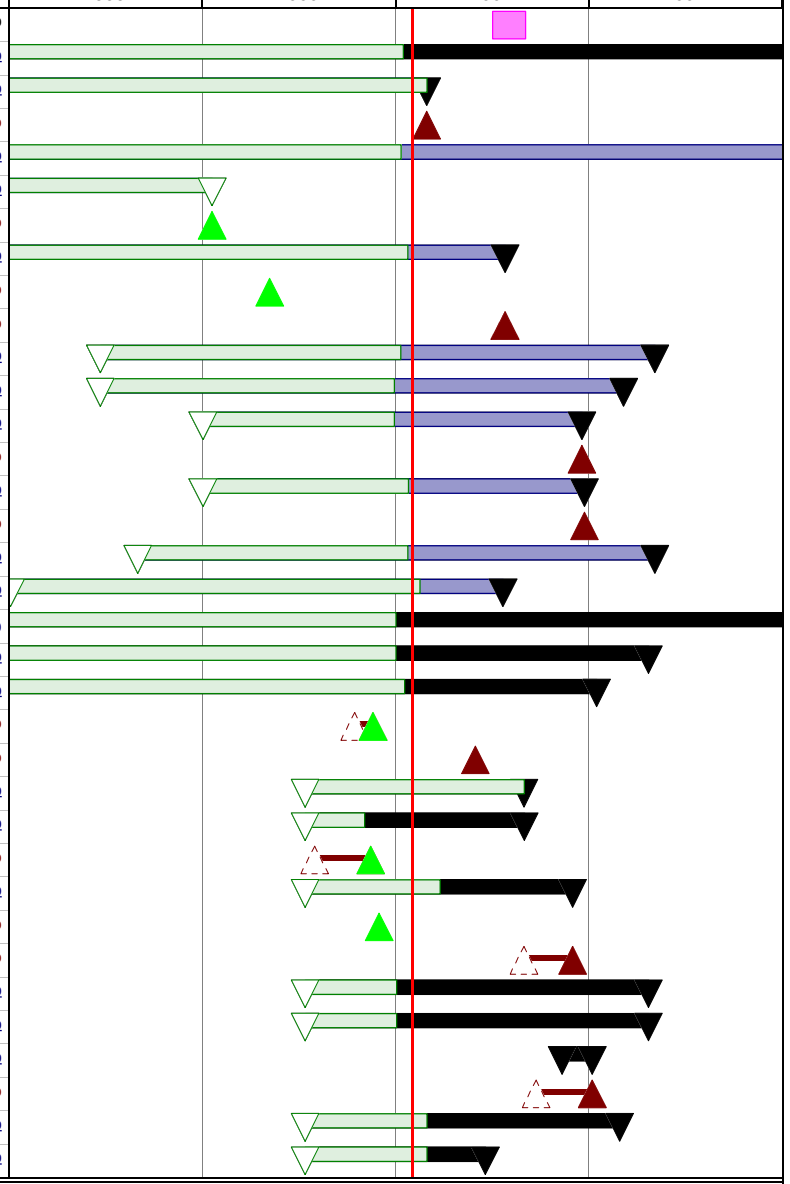
Line	WBS (f)	Task	Start	Finish	%done
1393	6.10.45.35	Test Bench qualification tests	2001-07-03	2001-09-03	0%
1411	**7**	**Correlator**	1998-06-01	2010-12-31	22%
1419	7.10	Test Correlator	1998-07-20	2001-03-01	99%
1425	**7.10.30**	**Deliver Test Correlator to Alma Test site**	**2001-03-01**	**2001-03-01**	**0%**
1426	7.15	Baseline Correlator	1998-07-03	2008-04-23	40%
1427	7.15.05	Baseline Correlator Preliminary Design	1998-09-15	2000-01-20	100%
1432	**7.15.05.25**	**PDR: Correlator**	**2000-01-20**	**2000-01-20**	**100%**
1433	7.15.10	Finite Impulse Response Filter Development	1998-07-03	2001-07-27	86%
1444	**7.15.10.40**	**PDR: Finite Impulse Response Filter**	**2000-05-08**	**2000-05-08**	**100%**
1451	**7.15.10.85**	**FIR Filter Performance Report**	**2001-07-27**	**2001-07-27**	**0%**
1452	7.15.15	Custom Board Development	1999-06-23	2002-05-06	44%
1453	7.15.15.05	Station Card	1999-06-23	2002-03-08	30%
1466	7.15.15.10	Correlator Card	2000-01-03	2001-12-19	52%
1475	**7.15.15.10.55**	**Deliver Correlator Card**	**2001-12-19**	**2001-12-19**	**0%**
1476	7.15.15.15	Long-Term Accumulator	2000-01-03	2001-12-24	46%
1485	**7.15.15.15.55**	**Deliver Long Term Accumulator**	**2001-12-24**	**2001-12-24**	**0%**
1486	7.15.15.20	System Control Card	1999-09-02	2002-05-06	47%
1496	7.15.20	Correlator Chip Development	1999-01-04	2001-07-23	82%
1545	**8**	**Computing Subsystem**	1998-06-01	2010-12-31	**4%**
1	8.03	Computing Development (Phase 1)	1998-06-01	2002-04-24	48%
2	8.03.05	Management	1998-06-01	2002-01-16	72%
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**	**2001-06-01**	**2001-06-01**	**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	50%
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%



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

Joint Task
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Summary (US)
Milestone
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Atacama Large Millimeter Array

ALMA Milestone Progress
(as of 2001-01-30)
Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress
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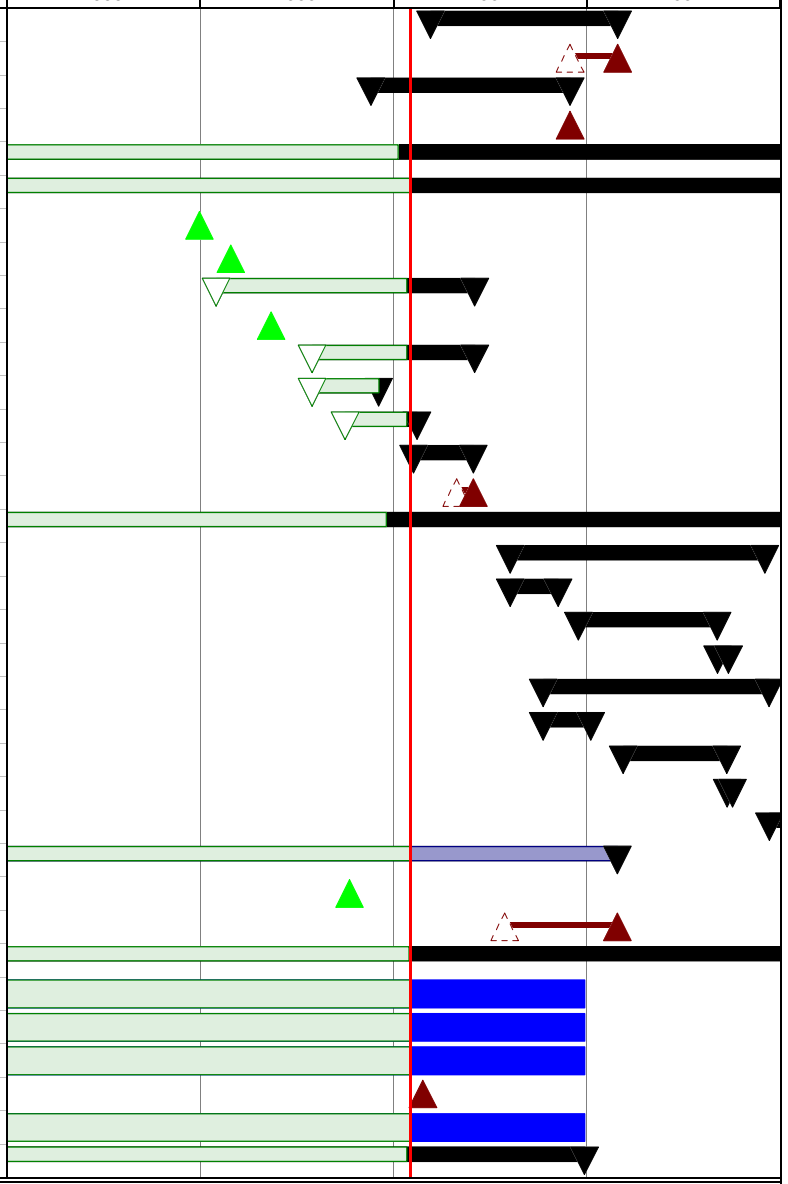
Line	WBS (f)	Task	Start	Finish	%done
237	8.03.37	Prototype Correlator	2001-03-12	2002-03-01	0%
244	**8.03.37.35**	**CDR: Prototype Correlator Software**	**2002-03-01**	**2002-03-01**	**0%**
270	8.03.65	Telescope Calibration	2000-11-19	2001-12-01	0%
276	**8.03.65.30**	**Release for Test Interferometer**	**2001-12-01**	**2001-12-01**	**0%**
1546	**9**	**System Engineering & Integration**	1998-06-01	2010-12-31	14%
1549	9.10	System Engineering	1998-06-01	2010-12-31	25%
1551	**9.10.10**	**System Block Diagram for Array**	**1999-12-31**	**1999-12-31**	**100%**
1553	**9.10.20**	**System Design Review**	**2000-02-28**	**2000-02-28**	**100%**
1556	9.12	Test Site Preparation/Outfitting	2000-02-01	2001-06-04	72%
1558	**9.12.10**	**Design Review: Test Int. Site Preparation**	**2000-05-15**	**2000-05-15**	**100%**
1559	**9.12.15**	**ALMATSF**	2000-07-31	2001-06-04	67%
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	82%
56	9.12.15.25	ANTENNA SITE FOUNDATIONS	2001-02-08	2001-06-01	0%
1561	**9.12.35**	**Test Interferometer Site Complete**	**2001-06-01**	**2001-06-01**	**0%**
1594	**9.15**	**ALMA Prototype Interferometer Evaluation**	**1998-06-01**	**2003-12-16**	8%
7	9.15.20	Vertex Antenna Integration and Testing	2001-08-10	2002-12-04	0%
9	9.15.20.10	Vertex Antenna Installation	2001-08-10	2001-11-08	0%
49	9.15.20.30	Vertex Antenna Systems Installation and Testing	2001-12-17	2002-09-05	0%
110	9.15.20.40	Millimeter Receiver Installation and Tests (Vertex)	2002-09-06	2002-09-26	0%
149	9.15.30	EIE Antenna Integration and Testing	2001-10-11	2002-12-12	0%
151	9.15.30.10	EIE Antenna Installation	2001-10-11	2002-01-09	0%
191	9.15.30.30	EIE Antenna Systems Installation and Testing	2002-03-11	2002-09-23	0%
248	9.15.30.35	Millimeter Receiver Installation and Tests (EIE)	2002-09-24	2002-10-04	0%
285	9.15.40	Interferometer Tests	2002-12-13	2003-03-11	0%
1595	9.20	Holography System	1998-09-01	2002-02-28	32%
1600	**9.20.25**	**CDR: Holography System**	**2000-10-10**	**2000-10-10**	**100%**
1611	**9.20.30**	**Deliver Holography System**	**2002-02-28**	**2002-02-28**	**0%**
1621	**10**	**Science**	1998-06-01	2009-12-31	54%
1622	10.05	Scientific Requirements	1998-06-01	2001-12-28	74%
1623	10.10	Site Monitoring and Characterization	1998-06-01	2001-12-28	74%
1624	10.15	Array Design and Operation	1998-06-01	2001-12-28	74%
1625	**10.17**	**PDR: ALMA Array Layout**	**2001-02-26**	**2001-02-26**	**0%**
1626	10.20	Calibration	1998-06-01	2001-12-28	74%
1627	10.25	Imaging	1998-06-01	2001-12-28	74%



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Summary (Joint)
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Milestone
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