

ALMA-US

BIMONTHLY REPORT
PERIOD END JULY 31, 2003

1 Overview

On July 25, 2003, the government of Chile, through its Ministry of Public Property, officially granted 17,700 hectares (68 square miles) of land in the Chajnantor region of the Atacama Desert in Chile for the construction and operation of the ALMA.

This action by the Chilean government marks a significant milestone for ALMA by providing a site capable of meeting all the stringent scientific demands of this telescope. The ALMA partners now have the necessary approval to begin construction of the infrastructure and facilities needed for the telescope.

Immediately following this action, the project initiated civil work on the site. Contractors began opening the road between the Chilean public highway and the Operations Support Facility (OSF) which will be constructed between the public road and the Array Operations Site (AOS). A formal groundbreaking ceremony is planned at the AOS in November 2003.

The second ALMA Week meeting was held in Victoria Canada beginning 2-June 2003. This meeting, with nearly one hundred participants, provided an opportunity for detailed discussions on all aspects of the project. As this was the first such meeting since the appointment of Massimo Tarengi as ALMA Director, it also was an opportunity for him to share his vision of the ALMA project. The meeting was organized with daily plenary sessions in the morning followed by afternoon parallel sessions. Minutes of the meetings and a summary of actions and decisions reached are available on the ALMA EDM system.

A two antenna prototype Correlator has been completed and is currently undergoing tests and software integration. This prototype Correlator uses identical boards as the full Correlator. Construction of the first of four quadrants of the Correlator will begin immediately after a Critical Design Review (CDR) scheduled for the October.

2 Programmatics

2.1 Financial Statement

Table A2 in the Appendix of this report shows the actual and budgeted expenditures by WBS Level 1 category. \$ 9.11M has been expended and committed fiscal 2003 to date. Project to date funds expended plus committed were \$20.34M.

2.2 Personnel

The ALMA Project staffing is reported in Table A1 in the Appendix. This table shows the staffing by WBS Level-1 category based on the joint project WBS. The total number of full-time equivalent employees was 95.8.

2.3 Progress towards Project Milestones

The following level one and level two milestones were scheduled for completion during the current period.

WBS MS #	Description	Planned Date	Actual Date Or Revised Date	Status	Resp
2.025 .8302	Access Road to OSF EU CDR Complete	2003-Jun-20	2003-Jun-09	Comp	ESO
2.025 .8304	Access Road OSF to AOS EU CDR Complete	2003-Jun-20	2003-Jun-09	Comp	ESO
3.035 .8530	Shared Access AEC Antenna (Preliminary Acceptance)	2003-Jul-07	2003-Sep-12	Resch	ESO
6.315 .9208	Correlator ICDs submitted for approval	2003-Jun-13	2003-Aug-13	Resch	NRAO
4.080 .8720	Freeze Dewar Design	2003-Jul-15	2003-Aug-31	Resch	ESO
4.090 .8770	Freeze windows/IR filters design	2003-Jun-30	2003-Jun-17	Comp	ESO
2.025 .8292	Construction Road Opening EU Construction Contract Signed	2003-May-20	2003-Jun-25	Comp	ESO
2.025 .8213	Freeze Joint Antenna Foundation Interface	2003-May-30	2003-Jun-30	Comp	Both
2.025 .8360	Freeze Fiber Optics and Electrical Specifications	2003-Jun-30	2003-Dec-31	Resch	Both
4.258 .8880	Deliver lab prototype LO chain to each cartridge man.	2003-Jun-30	2003-Aug-22	Resch	NRAO
9.380 .9812	Document on how calibration reqs flow down to instrumental specs	2003-June-30	2003-June-30	Comp	Both
9.380 .9815	Plan for Y+ configuration submitted	2003-June-30	2003-June-30	Comp	Both
1.015 .8165	Site available for Work	2003-Apr-01	2003-Jul-25	Comp	Both

A complete list of the level one and level two milestones is included as an attachment to this report.

2.4 Earned Value Analysis

An Earned Value Analysis for those ALMA tasks assigned to NRAO is shown below for the period ending May 2003.

Limitations in the tools currently used to time phase the budget assigned to individual tasks limits the absolute fidelity of the analysis, particularly where task costs are dominated by large contracts. The budget model used as the baseline for the Earned Value calculations assumes a fixed linear spending rate within each low level task. Actual spending in these cases occurs in discrete increments as commitments are made.

The project is currently investigating options to augment these tools and add resources to the project control function to improve the fidelity of the Earned Value calculations. While ESO does not currently utilize any Earned Value Analysis, we are working with the JAO and ESO to adopt a common set of tools, procedure and reporting formats across the entire project. In the meantime, the current analysis remains a useful tool for the North American project to identify cost and schedule issues and measure the impact of specific interventions.

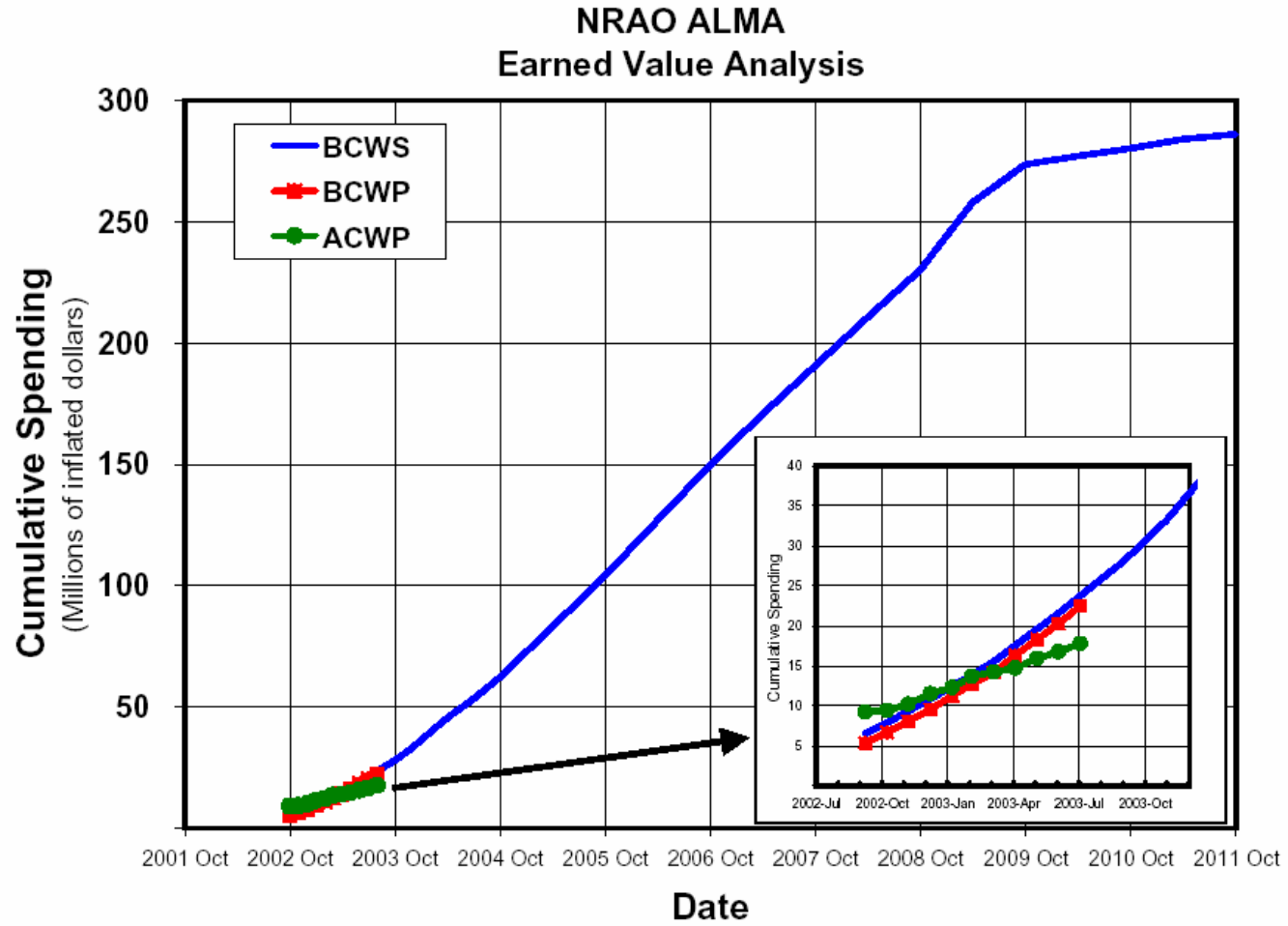
As compared to last reporting period, this earned value analysis shows a continuation of the positive cost variance. The overall schedule variance remains unchanged. The positive cost variance is dominated by the Site and Correlator WBS elements where the time phasing of large commitments are not well modeled by the cost database. This also creates the significant At-Completion positive variance. These anomalies will be attenuated when a number of large commitments are placed early in FY2004.

WBS # Task	<u>Cumulative to 2003-Jul-31</u>				Cost Perform. Index BCWP / ACWP	<u>Variance</u>		<u>At Completion</u>		
	BCWS	BCWP	ACWP	% Complete		Sched	Cost	Budgeted	Projected	Variance
	Budgeted Cost of Work Scheduled	Budgeted Cost of Work Performed	Actual Cost of Work Performed	BCWP / BAC		BCWP - BCWS	BCWP - ACWP	BAC 2002oct12d	BAC / CPI	
1 Management	1,601	1,601	1,490	12%	107%	0	111	13,159	12,245	914
2 Site	2,968	2,968	329	11%	903%	0	2,640	26,588	2,944	23,645
3 Antenna	1,203	1,452	1,072	1%	135%	249	380	124,990	92,264	32,725
4 Front End	6,841	5,982	6,361	16%	94%	(859)	(380)	38,068	40,484	(2,416)
5 Back End	3,872	3,446	3,556	9%	97%	(426)	(110)	37,960	39,166	(1,206)
6 Correlator	2,270	2,260	991	17%	228%	(10)	1,269	13,482	5,912	7,570
7 Computing	2,612	2,522	1,936	16%	130%	(89)	586	15,650	12,011	3,638
8 System	1,957	1,815	1,556	16%	117%	(142)	259	11,473	9,834	1,639
9 Science	445	445	496	10%	90%	0	(51)	4,665	5,203	(539)
Total	23,769	22,492	17,787	8%	126%	(1,277)	4,706	286,033	220,062	65,971

Earned Value Analysis for tasks assigned to NRAO.
Cumulative from October 1, 2001 through 31 July 2003

Notes:

1. All amounts are in k\$
2. Budgeted expenditures are reported in dollars of the year commitments are planned
3. Actual expenditures are in dollars of the year commitments are made
4. Budgeted amounts do not include contingency
5. Budgeted and actual amounts are exclusive of overhead



Earned Value Trends through 31 July 2003

2.5 Concerns

A comprehensive procurement strategy for the production antennas has not been agreed to between the JAO and the executives. Significant effort is required to prepare the documents necessary for this procurement. Continuing delays in defining the strategy could impact the schedule for initiating the procurement.

Continuing delays in the completion of the punch list for the VertexRSI antenna and delays in completing the assembly of the AEC antenna put the antenna evaluation schedule at risk. While good progress is being made evaluating the VertexRSI antenna, evaluation of the pointing performance cannot be completed until anomalies in the antenna positioning system are corrected by the contractor.

Other concerns are included in the individual reports of the Level 1 WBS reports.

3 ALMA Technical Memos Distributed This Period

462	Effects of Radiation on the ALMA Correlator	Joseph Greenberg (National Radio Astronomy Observatory)
463	Variation on the ALMA link design. No Switch, maximum 18km link lengths and the use of an APD.	Roshene McCool (The University of Manchester)
466	Gain Stability: Requirements and Design Considerations	Larry D'Addario
467	Measurements and Simulations of Overmoded Waveguide Components at 70-118 GHz, 220-330 GHz and 610-720 GHz	G. A. Ediss (NRAO)
468	Designs of Wideband 3dB Branch-line Couplers for ALMA Bands 3 to 10	Hiroya Andoh, Tetsuhiro Minamidani, Norikazu Mizuno, Akira Mizuno, Yasuo Fukui, Shin'ichiro Asayama, Yoshinori Yonekura, Hideo Ogawa
469	A Broadband Waveguide Thermal Isolator	J. L. Hesler , A. R. Kerr and N. Horner
470	RFI Survey at the ALMA Site at Chajnantor	Carla M. Beaudet, Galen Watts, Jeff Acree, Simon J. E. Radford (NRAO)
471	Site Properties and Stringency	Neal Evans (U. Texas), John Richer (MRAO Cambridge), Seiichi Sakamoto (NRO, Japan), Christine Wilson (McMaster, Canada), Diego Mardones (Universidad de Chile), Simon Radford (NRAO, Tucson), Selby Cull (NRAO, Tucson), Robert Lucas (IRAM)

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 Site

Permissions and access to the site were finally granted during this period. Civil work has now started on the site with the beginning of road opening at the site. Temporary roads are under construction between the public road and the OSF and then from the OSF to the AOS. (see picture below)



Road Opening Between the Public Road and the OSF

4.2 Antennas

A Statement of Work and a Technical Specification for the procurement of production antennas are being developed jointly by the ESO and NRAO Antenna IPT Leads. The goal is to produce a unified SOW and TS that will be used by both Executives for the procurement packages.

Evaluation of the VertexRSI antenna continues at the ATF site. Significant progress has been made in two of the main performance areas; surface accuracy and path length stability. The third area, pointing performance, has experienced delays because of anomalies in the antenna positioning system that inhibit evaluation of precision pointing performance.

Preliminary pointing measurements demonstrate pointing performance for the basic mechanical structure of the telescope. Anomalies in the positioning system software prevent comprehensive testing using the supplied real time metrology system (tilt-meters, etc.) which is required to meet the pointing specifications.

The four major deficiencies that must be resolved to complete pointing tests include:

1. Faulty ACU/PTC communications link. This link, which is carried over a contractor-supplied LAN, was a task which received a great deal of attention by the contractor during their recent visit to the ATF. Since the PTC delivers pointing model and metrology information to the ACU, faulty behaviour in the communications between these two computers is a major problem for pointing measurements. The contractor is working on a solution to this problem, which they would like to test on the APEX antenna in Chile before implementation on the VertexRSI antenna.
2. Large overshoot in position acquisition. The contractor has explained this problem as being due to an error in the way they calculate trajectories within the ACU. Instead of using position values which include pointing model and metrology corrections, they use positions derived from the encoders. In order to allow the AEG to proceed with antenna pointing studies, we have implemented a work-around to this problem which increases the stringency used to determine when the antenna is on-source, at the expense of lower telescope motion efficiency.
3. Multiple deficiencies of the VertexRSI tiltmeter system. Due to potential errors in measurement readout, miscalibration, and documentation inconsistency, the tiltmeter system is currently non-functional. A detailed report of this failure has been submitted via the ATF Problem Reporting system. The AEG has also performed extensive tests of this system over the past month to assist the contractor in isolating the problems with this system. A detailed analysis report describing the current perceived problems with this system has been submitted to the contractor.
4. Antenna does not properly position over-the-top. For positions beyond elevation 90deg (commonly referred to as “over-the-top”), the antenna does not properly acquire or track

astronomical sources. These problems have delayed our evaluation of the pointing performance of the VertexRSI antenna.

The contractor reports that it has diagnosed these problems and is in the process of developing and testing the software to correct these deficiencies. A schedule for the contractor to return to install and test the new software is being negotiated with the AEG.

Delivery of the AEC antenna, supplied by ESO, is now expected to occur no earlier than the end of September.

4.3 Frontend

At ALMA week on the 2-6 June in Victoria the current status of the front-end IPT was described to the rest of the project. Progress was made in developing the ICD's between the front-end and the rest of the project.

The front-end IPT organized an all-hands meeting in Groningen on the 16-18th of June. The meeting was very successful and provided IPT members with a general overview of the schedule, the overall receiver design and the way the various sub-systems integrate together. Representatives for each of the major sub-systems presented their designs. Particular progress was made in the following areas:

- Internal ICD's - in particular the cartridge/front-end interface
- Front-end specifications and requirements
- Receiver design
- Monitor and control concept
- Amplitude stability

The agenda, presentation and minutes are available on the ALMA EDM in the front-end IPT section

At the 2003 URSI meeting in Columbus Ohio (June 23-26th) the specifications and current designs for the ALMA front-end was presented

Weekly Front-End IPT telecons have been initiated, involving the lead, deputy and the sub-system engineers.

Band 6

The prototype mixer design meets ALMA specifications and details are available in the all-hands meeting folder on ALMA EDM. In an effort to out-source the IF amplifiers, two commercial suppliers have been contacted and a trial batch of six test amplifiers is being constructed. The supply of suitable TRW InP transistors remains a concern and discussions with JPL continue. The design of test-sets and their supporting software continues. The Japanese cartridge-test cryostat has been tested and after some technical

problems were resolved, works well. The assembly of a prototype cartridge is expected to be complete before the end of the year

Band 3

The design of a 4-12 GHz IF amplifier based on commercial InP transistors has been completed and a prototype amplifier will be tested in August. The design of test-sets and their supporting software continues. The Japanese cartridge-test cryostat has been tested and works well

Receiver design

The design and layout of the local oscillator and support electronics that is attached to each of the cartridges has been agreed with all parties. This design meets the technical requirements while at the same time allowing easy access and servicing. The design of the DC support electronics is well advanced. The overall space-envelope of the front-end assembly has been agreed and documented in the relevant ICD. Continued ATF support is hampering progress in the general receiver design area.

4.4 Backend

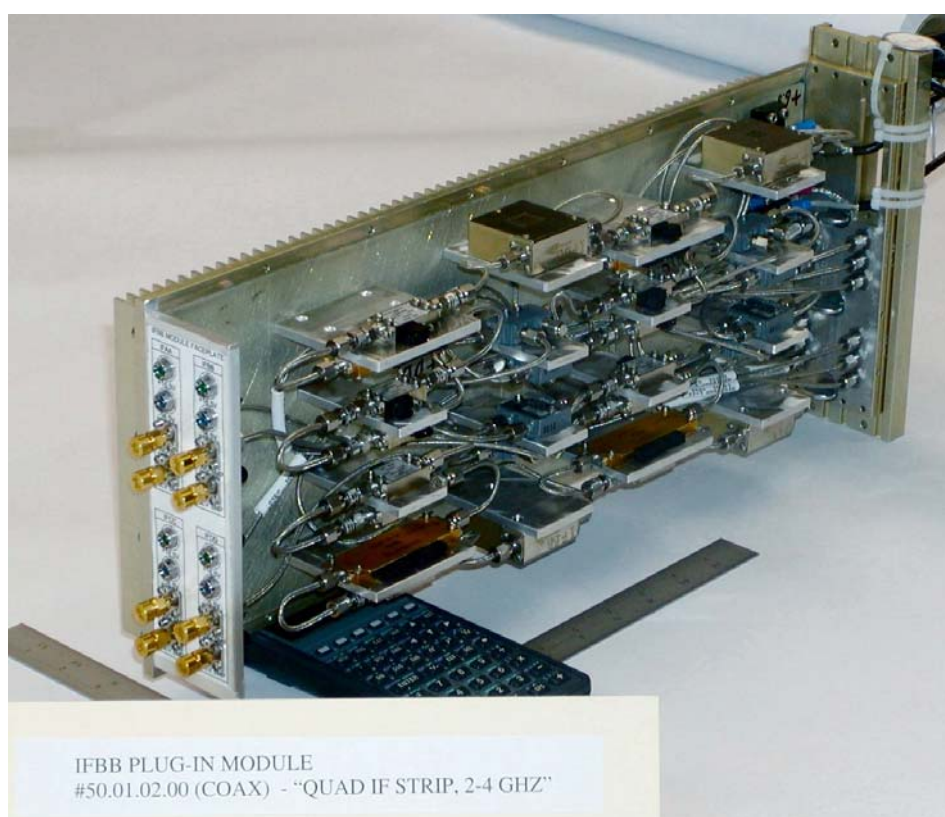
Budgetary estimate quotes on an integrated version of the downconverter show a potential savings during production of \$2M over the baseline connectorized version. An RFQ has been released for outside vendors to supply three prototype integrated modules. Vendor selection is scheduled for September 2003.

The lowpass filters used in the 2nd LO synthesizer originally consisted of two lowpass filter in series. The second lowpass was included in the part design to ensure a -40 dBstop band to 42 GHz, or the third harmonic of the highest synthesizer output frequency. The two lowpass filters were designed as two separate lowpass filters. One filter had an SMA male connector that allowed the two lowpasses to be cascaded. The 3rd harmonic performance of -47 dBm maximum was obtained with only the low frequency cutoff lowpass filter in the circuit. The other lowpass filter had been removed. This means the second lowpass filter was not needed to meet the performance requirement.

The plan for monitoring module voltages is to use ON Semiconductors Universal Voltage Monitors (MC33161) configured in a window detector mode. The $\pm 15V$ voltage monitors will be powered by the +5V supply while the +5V monitor will be powered by the +15V supply. The window detectors will be configured to give a logical high (Voltage good = True) if the voltages are within the window. The window is set by three resistors. The three resistors set the high and low window levels (when the monitor logic goes low) and some hysteresis levels to prevent monitor oscillation.

A preliminary failure modes and effects analysis (FMEA) was performed on the 2nd LO synthesizer as a check on the adequacy of the proposed monitor points. A couple of failure modes were found that are not easily detectable by monitor points. One failure mode, a loss of the 48 ms LVDS timing signal to the fine tuning synthesizer (FTS) is not currently detectable but a watchdog timer should be able to detect this failure. The preliminary FMEA may be found now on ALMA EDM.

A LabView based test set for observing the movement of digital data patterns from formatter to deformatter FPGAs has been developed. Several key FPGA firmware elements will be monitored so that data manipulation (protocol) can be observed at both ends of the DTS. This will prove to be very valuable in our troubleshooting by being able to follow data throughout the FPGAs.



ALMA Backend IF Strip Module

4.5 Correlator

The prototype two-antenna correlator continued detailed checkout. It was determined that the previously reported problem with a few bin-to-bin interfaces showing rare bit

errors can be corrected by using the next highest speed version of the relevant FPGA, which will be an insignificant total increase in cost. A new version of the station bin backplane was designed and sent for fabrication, correcting a design error in the original and providing greater flexibility in power distribution.

The optical receiver simulator card was completed and tested. This allows checkout of the correlator input interfaces with either the standard pseudo-random pattern for interface verification or actual samples of a noise source for long-term integration testing. The interfaces have been verified, and testing of the A/D mode will begin shortly.

Firmware development for advanced operation modes continued. Most of this is required in the LTA card, including:

- (1) Special adder tree modes required by the two-antenna prototype system;
- (2) Support of the operational environment of the two-antenna prototype system.

Most activity is now in the software area, since most hardware checkout is complete. This is concentrated on operational modes which will be required for the test interferometer.

RFI measurements using the two-antenna prototype correlator were begun. The goal is to determine the emission in the 4-12 GHz IF band, and in the 31.3-45 GHz range of Band 3. Data were collected using a room temperature NRAO LNA and standard pyramidal feed horn for Band 3, with the result that no emission above the noise floor of the receiver could be detected. Further measurements in the 4-12 GHz range are planned.

Detailed planning for construction of the 64-antenna correlator was carried out. This is primarily a plan for the major custom manufacturing tasks, namely the custom correlator chips and the custom boards. It appears that major cost savings are possible if all the boards are built at once, rather than in quarters.

Enhanced filter card

Further study and design of a possible enhancement of the baseline correlator performance has been done. By substituting an advanced filter card with multiple simultaneous output bands for the single-band output present filter design, it is possible to achieve much greater frequency resolution in the widest bandwidths, or to analyze several narrow bands simultaneously with even higher frequency resolution.

Simulation of the algorithm and detailed design of a practical card are in progress. The intent here is to verify the algorithm before committing to final board design and prototype construction.

Schedule

A goal for March-May 2003 which was not previously completed was:

Perform the first end-to-end testing of the entire prototype correlator.

This goal was completed.

The goals for June-July 2003 were:

- (1) Complete hardware checkout of the two-antenna prototype correlator;
- (2) Write preliminary version of firmware needed for the test interferometer;
- (3) Complete design and simulation of the enhanced filter card;

As of the end of July:

- (1) The hardware checkout of the two-antenna prototype correlator was completed, with the exception of the known error on the station bin motherboard previously mentioned.
- (2) A preliminary version of firmware needed for the test interferometer has been written.
- (3) Design and simulation of the enhanced filter card is about 80% done.

The goals for August-September 2003 are:

- (1) Fabricate, install, and test the revised station bin motherboard.
- (2) Complete design and simulation of the enhanced filter card.
- (3) Complete the Site and Back End ICDs and submit them for approval.
- (4) Set a date for the CDR and, if the scheduled date permits, conduct the review.
- (5) Test the A/D mode of the two-antenna correlator optical receiver simulator card to confirm operation using actual noise data.
- (6) Complete RFI measurements and write an RFI report.

4.6 Computing

The only scheduled level 2 milestone during this period was 9420, the first internal Computing CDR, was completed July 31 about 3 weeks later than scheduled. This was an extensive review, consisting of 14 separate review meetings. The review material and individual review reports with actions can be found at: <http://tinyurl.com/irio>.

A bug fix release (2.1) of the ALMA Common Software (ACS) was made. We also held a training course for ACS which had over 30 participants (ALMA and non-ALMA). We made good progress testing communications with the AEC Antenna ACU at the Microgate development facility. Integration and test for the first whole-software release

(R0) was successfully completed. This was basically an exercise to debug the release procedures, the actual subsystems are largely stubbed. Source code for an intermediate whole-software release (R0+) was checked in during the period, although integration and test still remains to be completed (as scheduled). Software support for the ATF continued. First software-controlled end-to-end correlator testing commenced. Detailed use-case based test planning for subsystems was started, with a number of more detailed use cases developed. A number of important subjects (operations, communications, and hardware/software interface topics) were discussed at ALMA week.

4.7 Systems Engineering

The following documents have been updated and submitted for approval:

- 'ALMA Design Reviews Definitions, Guidelines and Procedures'
ALMA-80.09.00.00-001-B-PLA,
- 'ALMA Environmental Specification'
ALMA-80.09.00.00-001-B-PLA
- 'ALMA Power Quality (Compatibility Levels) Specification';
ALMA-80.05.00.00-001-B-SPE and
- 'Standard for Power Plugs, Socket-outlets, and Couplers';
ALMA-80.05.00.00-004-A-STD

The last two documents were approved by the Configuration Control Board.

The document "Product Assurance Requirements" was circulated for IPT level review and is now in the final stages of editing. This document will be submitted to configuration control in August.

These documents will be needed for a System Requirements Review (SRR) to be held in September 2003 (level 2 milestone 8.365.9602). Invitations to participate in this review along with a list of required documents were sent to all IPT leads.

A document "General Safety Specification for ALMA Project" has been drafted. This will serve as the top level engineering safety specification for the ALMA project.

A meeting was held the week of July 28th in Socorro, NM to finalize safety requirements applicable to equipment design. The meeting was attended by representatives of ALMA system engineering and safety from both ESO and NRAO.

The LO prototype system integration plans were discussed at a meeting in Tucson the week of July 21st. Several scenarios were developed which culminate with the installation the ALMA prototype electronic systems on the ATF antenna in Q3 2004. There was no decision on a plan at this time.

The scope of the Correlator CDR has been agreed upon between the System Engineering and Correlator IPTs. The table of External ICDs has been updated.

The requirement allocation for gain (total power) stability was defined, based on the science requirements. These have been given to the Front End and Back End IPTs.

4.8 Imaging and Calibration

Overview

Science IPT Activities

During June-July, Science Group activities centered around final design for the extended ALMA configuration (submitted), preparation of the ALMA Science Requirements document, preparation of the ALMA Calibration Strategy Plan, initiation of the Design Reference Science Plan, discussions of Operations including how the plan described in Chapter 6 of the Project Plan might be improved, and also how the ALMA Science Center will operate. Responsibilities were shifted to accommodate the surprise departure of the ALMA Interim Project Scientist.

Joint NA/EU Science IPT staff and Calibration Group telecons were held monthly, and the weekly NA Science IPT telecons continued, beginning their sixth year (Agendas and notes for all meetings are available; this period's include telecons on 10 June (Science IPT), 17 June, 1 July, 8 July (Science IPT), 15 July and 29 July. During these telecons, progress on action items is tracked toward meeting milestones and assignments (new action items) are made to assure their timely completion. Level 2 Milestones met during June-July 2003 include:

- Science 9812 9.380.9812 Document on how calibration reqs flow down to instrumental specs 2003-Jun-30 Level 2 Done as modified at ALMA Week.
- Science 9815 9.380.9815 Plan for Y+ configuration submitted 2003-Jun-30 Level 2 Done X

There were eleven level 3 milestones met during the period and five of Level 3 and below were deferred during the shift of responsibilities mentioned above.

Anticipated problems:

The unexpected departure of the Interim Project Scientist, and the subsequent departure of other key players in the development of the calibration strategy could cause delay in the 30 September Level 2 Milestone for delivery of an ALMA Calibration Strategy. The Science IPT has secured promises that the departed members will continue to work on the strategy but its control of the situation is more limited; it has appointed an interim head of the Calibration Group, and it will shortly commence advertising to fill the vacant positions.

ASAC Meeting

In the absence of the Interim Project Scientist, Wootten aided in preparation of the agenda for the meeting in accord with the plans made by ASAC Chair John Richer and Vice Chair Lee Mundy. Wilson handled organization of the meeting, including all local aspects. Wootten, van Dishoeck, Emerson, Butler and Holdaway are expected to contribute presentations to the meeting.

ANASAC Meeting

Wootten prepared the agenda in consultation with Chairman Crutcher, Emerson and Lo. With advice from Crutcher and help from Rodriguez in Charlottesville he also handled meeting logistics. In consultation with Lo, Carilli and Emerson, he produced revisions of Chapter 6 of the Project Plan, as well as a possible outline of the ALMA Science Center to be located in Charlottesville.

Design Reference Science Project

During July, planning for the Design Reference Science Project culminated with issuance of a call for scientists to submit descriptions of a prototype suite of high-priority ALMA projects that could be carried out in 3 years of full ALMA operations. Many submissions were received during July toward a 15 August deadline for the first phase of this project. An October date for release to the Project is anticipated. This plan serves as a quantitative reference for developing the science operations plan, for performing imaging simulations, for software design, and for other applications within the ALMA project, including:

- allow cross-checking of the ALMA specifications against "real" experiments
- allow a first look at the time distribution for
 - configurations
 - frequencies
 - experimental difficulty (fraction of projects that are pushing ALMA specs)
- start developing observing strategies
- derive "use-cases" for the Computing IPT
- be ready in case some ALMA rescoping is required, or in case some ALMA specifications cannot be met.

Submissions from four major ALMA science themes including twenty-one subtheme topics have been sought.

APPENDIX

**TABLE A1
ALMA-US
PROJECT STAFFING
PERIOD END JULY 2003**

WBS Task Name	Full-time Equivalent Employees
Administration	2.3
Site Development	0.5
Antennas	4.9
Front End	30.6
Back End	16.2
Correlator	5.5
Computing	16.4
System Integration	16.8
Calibration	2.6
TOTAL:	95.8

Note: The FTE totals above include an allocation for 14 FTE paid by ALMA for overhead functions.

TABLE A2
ALMA-US
PROJECT FINANCIAL SUMMARY

Project Expenditures and Commitments Period End July 31, 2003				
WBS	FY2003 to Date		Project To Date	
	FY 2003 Budget	Actual	Project Budget	Actual
1. Admin	1,266,000	832,248	11,796,000	1,706,680
2. Site	3,964,000	280,373	22,873,000	376,439
3. Antenna	1,083,000	568,435	98,095,000	1,228,201
4. Front End	8,377,000	2,365,777	47,628,000	7,287,060
5. Back End	2,836,000	1,988,258	33,052,000	4,072,977
6. Correlator	3,625,000	563,166	12,148,000	1,135,341
7. Computing	2,096,000	1,249,882	16,158,000	2,217,689
8. Systems	1,681,000	1,003,798	10,839,000	1,782,327
9. Science	493,000	255,863	4,527,000	568,191
Totals	\$ 25,421,000	\$ 9,107,800	\$ 257,116,000	\$ 20,374,905

TABLE A3

Project Commitment Authority Period End July 31, 2003	
Commitment Authority	Amount
Received in FY2002	12,486,017
Received in FY2003	29,793,561
TOTAL	42,279,578
Expended & Committed	20,374,903
Remaining Commitment Authority	\$ 21,904,675

Notes:

1. Budget allocations based on current ALMA Project Plan. Budget allocations to IPTs do not include contingency.
2. The financial data contained in this report are unaudited and are provided here for reference. The NRAO fiscal division supplies audited financial data.

ALMA Milestone Summary (Version: 2003jul28a)

Legend: Level 1:1 Level 2:X Level 3:O (Original dates in gray)

WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.010.8105	Designation of responsibility for Phase 2 development work elements in Europe	2003-Sep-15	2		XX									
1.015.10301	ALMA Board Face to Face Meeting	2003-Feb-24	3		O									
1.015.10302	ALMA Board Teleconference	2003-Mar-27	3		O									
1.015.10303	ALMA Board Teleconference	2003-Apr-29	3		O									
1.015.10304	ALMA Board Face to Face Meeting	2003-May-26	3		O									
1.015.10305	ALMA Week (Start)	2003-Jun-02	3		O									
1.015.10306	AMAC Meeting October 2003 (TBC)	2003-Oct-13	3			O								
1.015.10307	ALMA Week 2003 October (TBC)	2003-Oct-20	3			O								
1.015.10309	ALMA Board Teleconference (TBC)	2003-Aug-07	3			O								
1.010.20301	AUI Santiago Contract/Business manager starts	2003-May-12	3		OO									
1.010.8110	Designation of responsibility for Phase 2 production work elements in Europe	2004-Jul-01	2				X							
1.010.8120	Executives submit 2003 budget and financial projections to JAC	2003-Feb-05	2		X									
1.010.8121	Executives submit 2002 financial report (actual expenditures and value earned) to JAO	2003-Apr-28	2		XX									
1.010.8122	Executives submit 2004 budget and financial projections to JAC	2003-Sep-01	2		X									
1.010.8123	Executives submit 2003 financial report (actual expenditures and value earned) to JAO	2004-Feb-28	2			X								
1.010.8124	Executives submit 2005 budget and financial projections to JAC	2004-Sep-01	2				X							
1.010.8125	Executives submit 2004 financial report (actual expenditures and value earned) to JAO	2005-Feb-28	2					X						
1.010.8126	Executives submit 2006 budget and financial projections to JAC	2005-Sep-01	2						X					
1.010.8127	Executives submit 2005 financial report (actual expenditures and value earned) to JAO	2006-Feb-28	2							X				
1.010.8128	Executives submit 2007 budget and financial projections to JAC	2006-Sep-01	2								X			
1.010.8129	Executives submit 2006 financial report (actual expenditures and value earned) to JAO	2007-Feb-28	2									X		
1.010.8130	Executives submit 2008 budget and financial projections to JAC	2007-Sep-01	2										X	
1.010.8131	Executives submit 2007 financial report (actual expenditures and value earned) to JAO	2008-Feb-28	2											X
1.010.8132	Executives submit 2009 budget and financial projections to JAC	2008-Sep-01	2											
1.010.8133	Executives submit 2008 financial report (actual expenditures and value earned) to JAO	2009-Feb-28	2											
1.010.8134	Executives submit 2010 budget and financial projections to JAC	2009-Sep-01	2											
1.010.8135	Executives submit 2009 financial report (actual expenditures and value earned) to JAO	2010-Feb-28	2											
1.010.8136	Executives submit 2011 budget and financial projections to JAC	2010-Sep-01	2											
1.010.8137	Executives submit 2010 financial report (actual expenditures and value earned) to JAO	2011-Feb-28	2											
1.010.10310	GPRA - Initiate design contracts for site roads, buildings and utilities (3rd Quarter)	2002-Nov-15	3		O	O								
1.010.10311	GPRA - Complete assessment of antenna prototype performance	2003-Dec-31	3			O								
1.010.10312	GPRA - Deliver prototype correlator	2003-Dec-31	3			O								
1.010.10313	GPRA - Deliver prototype IF transmission system	2003-Dec-31	3			O								
1.010.10314	GPRA - Let contract for fabrication of production quantities of SIS mixers for 211-275 GHz receiver band	2002-Dec-20	3		O	O								
1.010.10315	GPRA - Release draft RFP for ALMA Antenna production units	2003-Dec-31	3			O								
1.010.10410	GPRA - Begin integration of Back End hardware	2004-Jun-30	3			O								
1.010.10411	GPRA - Begin initial phase of site construction	2004-Jun-30	3			O								
1.010.10412	GPRA - Evaluate proposals for ALMA Production Antennas	2004-Sep-30	3			O								
1.010.10413	GPRA - Award production antenna contract	2004-Sep-30	3			O								
1.010.10510	GPRA - Complete initial phase of site construction	2005-Dec-31	3				O							
1.010.10610	GPRA - First production antenna unit delivered to Chile and installed on site	2006-Dec-31	3					O						
1.010.10611	GPRA - First quadrant of correlator delivered to Chile	2006-Dec-31	3					O						
1.010.10612	GPRA - First antenna testing front end delivered to Chile	2006-Dec-31	3					O						
1.010.10710	GPRA - Complete infrastructure for engineering and commissioning observations	2007-Dec-31	3						O					
1.010.10711	GPRA - First complete production front end delivered to Chile	2007-Dec-31	3						O					
1.010.10810	GPRA - First ALMA interim science observations	2008-Dec-31	3							O				
1.010.10811	GPRA - A total of 19 antennas will have been delivered to Chile	2008-Dec-31	3							O				
1.010.10910	GPRA - Full correlator completed in Chile	2009-Dec-31	3								O			
1.010.10911	GPRA - Total of 34 antennas will have been delivered to Chile	2009-Dec-31	3								O			
1.010.11010	GPRA - Begin final phase of site work	2010-Dec-31	3									O		
1.010.11011	GPRA - Total of 49 antennas will have been delivered to Chile	2010-Dec-31	3									O		

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.015.8050	Completion of Construction Project	2011-Dec-31	1											1
1.015.8165	Site available for Work	2003-Jul-25	2		XX									
1.015.8170	Submit 2003 budget and financial projections to ALMA Board	2003-Feb-11	2		X									
1.015.8171	Submit 2002 financial report (actual expenditures and value earned) to ALMA Board	2003-May-26	2		XX									
1.015.8227	ALMA Groundbreaking	2003-Nov-03	2			X								
1.015.8172	Submit 2004 budget and financial projections to ALMA Board	2003-Sep-30	2		X									
1.015.8173	Submit 2003 financial report (actual expenditures and value earned) to ALMA Board	2004-Mar-31	2			X								
1.015.8174	Submit 2005 budget and financial projections to ALMA Board	2004-Sep-30	2				X							
1.015.8175	Submit 2004 financial report (actual expenditures and value earned) to ALMA Board	2005-Mar-31	2				X							
1.015.8176	Submit 2006 budget and financial projections to ALMA Board	2005-Sep-30	2					X						
1.015.8177	Submit 2005 financial report (actual expenditures and value earned) to ALMA Board	2006-Mar-31	2					X						
1.015.8178	Submit 2007 budget and financial projections to ALMA Board	2006-Sep-30	2						X					
1.015.8179	Submit 2006 financial report (actual expenditures and value earned) to ALMA Board	2007-Mar-31	2						X					
1.015.8180	Submit 2008 budget and financial projections to ALMA Board	2007-Sep-30	2							X				
1.015.8181	Submit 2007 financial report (actual expenditures and value earned) to ALMA Board	2008-Mar-31	2							X				
1.015.8182	Submit 2009 budget and financial projections to ALMA Board	2008-Sep-30	2								X			
1.015.8183	Submit 2008 financial report (actual expenditures and value earned) to ALMA Board	2009-Mar-31	2									X		
1.015.8184	Submit 2010 budget and financial projections to ALMA Board	2009-Sep-30	2										X	
1.015.8185	Submit 2009 financial report (actual expenditures and value earned) to ALMA Board	2010-Mar-31	2											X
1.015.8186	Submit 2011 budget and financial projections to ALMA Board	2010-Sep-30	2											
1.015.8187	Submit 2010 financial report (actual expenditures and value earned) to ALMA Board	2011-Mar-31	2											X
2.025.8208	Final Approval of Architectural program for all AOS buildings	2003-Mar-03	2		X									
2.025.8212	Draft Joint Antenna Foundation Interface	2003-Mar-06	2		X									
2.025.8213	Freeze Joint Antenna Foundation Interface	2003-Jun-30	2		XX									
2.025.8216	Freeze Central Cluster Configuration	2003-Mar-01	2		X									
2.025.8220	Award Contract Design / Engineering for AOS Facilities NA	2002-Oct-09	2		X									
2.025.8222	AOS Foundations NA Central Cluster CDR	2003-Sep-30	2		X	X								
2.025.8224	AOS Foundations NA Central Cluster Construction Tender Docs Complete	2003-Nov-30	2		X	X								
2.025.8226	AOS Foundations NA Central Cluster Construction Contract Signed	2003-Oct-01	2			X								
2.025.8010	Begin initial Phase of Civil Work in Chile	2003-Dec-31	1		1									
2.025.8228	AOS Foundations NA Central Cluster Provisional Acceptance	2005-Jun-30	2				X							
2.025.8230	AOS Foundations NA Remaining Construction / Tender Docs Complete	2005-Mar-01	2				X							
2.025.8232	AOS Foundations NA Remaining Construction Contract Signed	2005-Sep-01	2					X						
2.025.8234	AOS Foundations NA Remaining Provisional Acceptance	2007-Jun-01	2						X					
2.025.8236	AOS Foundations EU Design/Eng Contract Awarded	2007-Jan-01	2						X					
2.025.8238	AOS Foundations EU CDR Complete	2007-Apr-01	2						X					
2.025.8240	AOS Foundations EU Construction / Tender Docs Complete	2007-Jul-01	2						X					
2.025.8242	AOS Foundations EU Construction Contract Signed	2008-Mar-01	2							X				
2.025.8244	AOS Foundations EU Provisional Acceptance	2011-Oct-01	2											X
2.025.8250	AOS Buildings NA Foundations/Envelope CDR Complete	2003-Oct-31	2		X	X								
2.025.8252	AOS Buildings NA Foundations/Envelope Construction / Tender Docs Complete	2004-Mar-15	2		X	X								
2.025.8254	AOS Buildings NA Foundations/Envelope Construction Contract Signed	2003-Dec-31	2			X								
2.025.8258	AOS Buildings NA Foundations/Envelope Provisional Acceptance	2004-Aug-31	2				X							
2.025.8260	AOS Buildings Finish & Installations NA CDR Complete	2003-Aug-31	2		X									
2.025.8262	AOS Buildings Finish & Installations NA Construction / Tender Docs Complete	2003-Nov-30	2		X									
2.025.8264	AOS Buildings Finish & Installations NA Construction Contract Signed	2004-Jul-01	2			X								
2.025.8266	AOS Buildings Finish & Installations NA Provisional Acceptance	2005-Jun-30	2				X							
2.025.8025	Initial Phase of Civil Work in Chile Complete	2005-Jun-30	1				1							
2.025.20701	AOS Interconnect Roads & Trenches NA Provisional Acceptance	2007-Jun-30	2						X					
2.025.20702	AOS Interconnect Roads & Trenches EU CDR Complete	2007-Apr-01	3						O					
2.025.20703	AOS Interconnect Roads & Trenches EU Construction / Tender Docs Complete	2007-Jul-01	3						O					

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Legend: Level 1:1 Level 2:X Level 3:0 (Original dates in gray)

WBS #	Milestone Name	Due Date	Level	Legend: Level 1:1 Level 2:X Level 3:0 (Original dates in gray)												
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		
2.025.8282	AOS Interconnect Roads & Trenches EU Construction Contract Signed	2008-Mar-01	3								o					
2.025.8284	AOS Interconnect Roads & Trenches EU Provisional Acceptance	2011-Oct-01	2													X
2.025.8286	Complete AOS Construction	2011-Oct-01	2													X
2.025.8290	Construction Road Opening EU Construction / Tender Docs Complete	2003-Feb-26	2		X											
2.025.8292	Construction Road Opening EU Construction Contract Signed	2003-Jun-25	2		X											
2.025.8294	Construction Road Opening EU Provisional Acceptance	2003-Sep-30	2			X										
2.025.8300	Access Road EU Design/Eng Contract Awarded	2003-Mar-17	2		X											
2.025.8302	Access Road to OSF EU CDR Complete	2003-Jun-09	2		X	X										
2.025.8304	Access Road OSF to AOS EU CDR Complete	2003-Jun-09	2		X											
2.025.8306	Access Road EU Construction / Tender Docs Complete	2003-Aug-18	2			X										
2.025.8308	Access Road EU Construction Contract Signed	2004-May-30	2				X									
2.025.8310	Access Road OSF-AOS ready to accommodate transporter	2005-Jun-30	2					X								
2.025.8312	Access Road EU Provisional Acceptance	2008-Dec-31	2									X				
2.025.8320	ALMA Camp Construction / Tender Docs Complete	2003-May-06	3		o	o										
2.025.8324	ALMA Camp Construction Contract Signed, Work begins	2003-Jul-01	3		o	o										
2.025.8326	ALMA Camp Provisional Acceptance	2003-Aug-15	3			o										
2.025.8330	Contractors Camp Construction / Tender Docs Complete	2003-May-06	3		o	o										
2.025.8332	Contractors Camp Construction Contract Signed, Work begins	2003-Jul-27	3		o	o										
2.025.8334	Contractors Camp Provisional Acceptance	2003-Oct-30	2			X										
2.025.8340	OSF Facilities Phase 1 (Tech area) EU Design/Eng Contract Awarded	2003-Aug-15	2		X	X										
2.025.8342	OSF Facilities Phase 1 (Tech area) EU CDR Complete	2003-Sep-15	2			X										
2.025.8344	OSF Facilities Phase 1 (Tech area) EU Construction / Tender Docs Complete	2003-Dec-31	2			X										
2.025.8346	OSF Facilities Phase 1 (Tech area) EU Construction Contract Signed	2004-Apr-01	2				X									
2.025.8348	OSF Facilities Phase 1 (Tech area) EU Provisional Acceptance	2005-Jul-31	2					X								
2.025.8350	OSF Facilities Phase 2 (Res. / Visitor) EU Design/Eng Contract Awarded	2008-Oct-01	2									X				
2.025.8352	OSF Facilities Phase 2 (Res. / Visitor) EU CDR Complete	2009-Mar-31	2									X				
2.025.8354	OSF Facilities Phase 2 (Res. / Visitor) EU Construction / Tender Docs Complete	2009-Jul-01	2										X			
2.025.8356	OSF Facilities Phase 2 (Res. / Visitor) EU Construction Contract Signed	2010-Jan-01	2											X		
2.025.8358	OSF Facilities Phase 2 (Res. / Visitor) EU Provisional Acceptance	2011-Oct-01	2													X
2.025.8360	Freeze Fiber Optics and Electrical Specifications	2003-Jun-30	2		X											
2.025.8362	Fiber Optic Cables and Electrical Cables in Chile, N.A.	2004-Sep-15	2				X									
2.025.8364	OSF-AOS Fiber Optics Link Installed	2006-Dec-31	2					X								
2.025.8366	Fiber Optic Cables and Electrical Cables in Chile, Eur.	2008-Sep-01	2							X						
2.025.8370	Power Feasibility Study Completed	2003-Apr-07	2		X	X										
2.025.8372	ALMA Project Power Supply Plan Approved	2003-Aug-31	2			X										
2.025.8374	ALMA Permanent Power Supply Tender Docs Complete	2003-Dec-31	2			X										
2.025.8376	ALMA Permanent Power Supply Contract Signed	2004-May-31	2				X									
2.025.8378	Provisional Acceptance Power Supply Contract Phase 1	2005-Jun-30	2					X								
2.025.8410	Start Operations Budget	2006-Jan-01	2					X		X						
2.025.8380	Provisional Acceptance Power Supply Contract Last Phase	2006-Dec-31	2						X							
2.025.8390	Board Decision Location/Size Santiago JAO Office	2004-Jul-01	2				X									
2.025.8391	Architectural Design Contract awarded Santiago JAO Office	2004-Sep-01	2				X									
2.025.8392	CDR Santiago JAO Office	2004-Nov-01	2					X								
2.025.8393	Construction Tender Docs Complete Santiago JAO Office	2004-Dec-01	2					X								
2.025.8394	Construction Contract signed Santiago JAO Office	2005-Jan-01	2						X							
2.025.8395	Provisional Acceptance Santiago JAO Office	2006-Jan-01	2						X							
3.035.8502	Shared Access VertexRSI Antenna	2002-Nov-15	2		X											
3.035.8503	Deliver Foundation Design requirements	2003-May-02	2		X	X										
3.035.8505	Provisional Acceptance of VertexRSI Antenna	2003-Mar-20	2		X											
3.035.30301	VertexRSI completes initial punch list	2003-Aug-28	3		o	o										
3.035.8510	Complete Technical Performance Report-VertexRSI Antenna	2003-Aug-29	2		X	X										

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Legend: Level 1:1 Level 2:X Level 3:0 (Original dates in gray)

WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3.035.30332	Complete Service and Maintenance Vertex RSI Antenna	2003-Aug-29	3		o									
3.035.8515	Interim Antenna Technical Performance Report-AEC Antenna	2003-Aug-29	2		X									
3.035.8530	Shared Access AEC Antenna (Preliminary Acceptance)	2003-Aug-24	2		XX									
3.035.8540	Provisional Acceptance of AEC Antenna	2003-Sep-12	2		X									
3.035.8545	Complete Technical Performance Report-AEC Antenna	2003-Oct-31	2		XX									
3.045.8500	RFQ for VertexRSI Antenna Delivered to Project Office	2003-May-20	2		XX									
3.045.30302	Antenna / Station ICD Submitted to ALMA EDM	2003-Jun-07	3		o									
3.045.30303	AEC Antenna / Holography Mounting Confirmed	2003-Jul-24	3		o									
3.045.30304	AEC Optical Pointing Telescope Ready for Antenna Installation	2003-Jul-29	3		o									
3.045.30305	Transporter Feasibility Studies Report	2003-Jul-30	3		o									
3.045.30306	Antenna / Electric Power ICD Submitted to ALMA EDM	2003-Jul-11	3		o									
3.045.30307	Production Antenna SOW First Draft Ready	2003-Jul-31	3		o									
3.045.30308	Production Antenna Technical Specification First Draft Ready	2003-Jul-31	3		o									
3.045.30309	Status List of Antenna Design Documentation for Production Bid Package to Massimo	2003-Jul-31	3		o									
3.045.30310	Antenna / M & C ICD Submitted to ALMA EDM	2003-Jul-24	3		o									
3.045.30311	Specification for Basic Antenna Definitions submitted to ALMA EDM	2003-Aug-13	3		o									
3.045.30312	Antenna / FE ICD Submitted to ALMA EDM	2003-Aug-11	3		o									
3.045.30313	Antenna / BE ICD submitted to ALMA EDM	2003-Aug-11	3		o									
3.045.30314	Antenna -Transporter ICD Submitted to ALMA EDM	2003-Aug-11	3		o									
3.045.30315	Nutator Installed and tested on VertexRSI Antenna	2003-Aug-22	3		o									
3.045.30316	Antenna / FE Service Vehicle ICD Submitted to ALMA EDM	2003-Aug-12	3		o									
3.045.30317	Transporter - Site ICD Submitted to ALMA EDM	2003-Aug-15	3		o									
3.045.30318	AEC Antenna Design Documentation package for CFT/RFQ	2003-Aug-25	3		o									
3.045.30319	VertexRSI Antenna Design Documentation package for CFT/RFQ	2003-Aug-25	3		o									
3.045.30320	ESO T & Cs Completed for Production Contract	2003-Aug-19	3		o									
3.045.30321	NRAO T & Cs Completed for Production Contract	2003-Aug-19	3		o									
3.045.30322	Front End Receiver Interface Plate for AEC Antenna Completed	2003-Aug-26	3		o									
3.045.30323	Pre-Bidders Meeting at ATF	2003-Sep-17	3		o									
3.045.30324	Bidders Meeting at OSF	2003-Oct-29	3		o									
3.045.30325	Transporter Specification and SOW submitted to ALMA EDM	2003-Nov-28	3		o									
3.045.30326	Transporter Critical Design Review Completed	2003-Dec-17	3		o									
3.045.30401	Transporter Procurement Documents Ready	2004-Jan-15	3			o								
3.045.30402	Transporter Contract PDR	2004-Apr-01	3			o								
3.045.30403	Transporter Contract FDR	2004-Jun-25	3			o								
3.045.8524	Prototype Antenna released to Contractor for Refurbishment / Transport to Chile	2004-Aug-28	2			X								
3.045.30501	Transporter Acceptance Europe	2005-Jun-28	3				o							
3.045.8525	CFT/RFQ Bid Package Submitted to Project Office (AEC/VertexRSI)	2003-Aug-26	2		XX									
3.045.8535	Issue CFT/RFQ for Production Antenna Design(s)	2003-Sep-26	2		XX									
3.045.8550	Closing Date for Production Antenna Bids (Competitive Tender)	2004-Jan-23	2			XX								
3.045.8560	Bid Evaluations Due to Project Office	2004-Mar-26	2			X								
3.050.8565	Sign Contract for 31+1 North Am. Production Antennas	2004-Jul-28	2		X	X								
3.050.8575	Sign Contract for 32-Euro Production Antennas	2004-Jul-28	2			XX								
3.050.8585	First Antenna Arrives at OSF (Retrofitted prototype TBC)	2005-Oct-31	2				X							
3.050.8035	First Production Antenna available in Chile at OSF	2005-Dec-31	1				1							
3.060.8600	8th Antennas Preliminary Accepted at OSF	2007-Feb-28	2					X						
3.060.8605	20th Antennas Preliminary Accepted at OSF	2008-Jun-12	2						X					
3.060.8610	30th Antennas Preliminary Accepted at OSF	2009-Jun-12	2							X				
3.060.8615	50th Antennas Preliminary Acceptance at OSF	2010-May-31	2								X			
3.060.8620	All Antennas Preliminary Accepted at OSF	2011-Jun-30	2									X		
3.060.8625	All Antenna Provisionally Accepted in Chile at AOS	2011-Dec-16	2										X	
3.065.8555	Nutator Critical Design Review Completed	2004-Oct-28	2		X	X								

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
3.065.8590	All Nutators Accepted at OSF	2006-Apr-15	2					X						
3.070.8569	Transporter CFT Critical Review Completed	2003-Nov-21	2		X	X								
3.070.8570	Issue CFT for Transporter	2004-Feb-17	2			X								
3.070.8580	First Transporter Accepted at OSF	2005-Sep-30	2				X							
3.070.8595	Second Transporter Accepted at OSF	2006-Sep-15	2					X						
4.075.8700	Initial set of FE specs and interface-control documents discussed	2003-Apr-01	2		X									
4.075.8705	FE specifications and requirements plus ICD's submitted for approval	2003-Sep-01	2		XX									
4.075.8990	Front end sub-system Delta PDR	2003-Sep-01	2		X									
4.075.8995	All FE Contracts / Agreements in place	2003-Sep-01	2		XX									
4.075.40301	Cartridge manufacturers PDR's	2004-Jul-01	3			O								
4.075.9020	RECEIVER CDR	2006-May-01	2					XX						
4.075.9023	FE Production authorized	2006-May-01	2					X						
4.080.40302	Cartridge test dewars available	2003-Mar-01	3		O									
4.080.8720	Freeze Dewar design	2003-Aug-31	2		X									
4.080.40303	Cryogenic performance available	2003-Jun-17	3		OO									
4.080.8740	Prototype cartridge bodies (plus dummies) delivered	2003-Jan-01	2		X									
4.080.40304	Dead line for input on cartridge design modifications	2003-Jul-01	3			O								
4.080.8750	Cartridge body design frozen	2003-Sep-01	2		X									
4.085.8730	Receiver Dewar #1 delivered to integration centre	2004-Jan-01	2			X								
4.085.8735	Receiver Dewar #8 delivered to integration centre	2005-Jul-01	2				X							
4.085.8755	Cartridge bodies for first receiver delivered	2004-Jan-01	2			X								
4.085.8760	Cartridge bodies for eighth receiver delivered	2004-Jul-01	2			X								
4.090.8765	Freeze optics design	2003-Aug-31	2		XX									
4.090.8770	Freeze windows/IR filters design	2003-Jun-17	2		X									
4.095.8775	Warm optics for receiver #1 delivered	2004-Jan-01	2			X								
4.095.8780	Windows/IR filters for receiver #1 delivered	2004-Jan-01	2			X								
4.095.8785	Warm optics for receiver #8 delivered	2005-Jul-01	2				X							
4.095.8790	Windows/IR filters for receiver #8 delivered	2005-Jul-01	2				X							
4.100.8810	Deliver lab-prototype DC bias circuits	2003-Apr-24	2		XX									
4.305.40305	Dead line for input on DC bias circuits requirements	2003-Aug-01	3			O								
4.100.8820	Freeze the design of the DC support electronics	2003-Oct-01	2			X								
4.100.8835	Deliver lab prototype M/C circuit	2003-May-22	2		X									
4.100.40306	Dead line for input on M&C circuit requirements	2003-Aug-01	3			O								
4.100.8845	Freeze hardware design M&C circuit	2003-Oct-01	2			X								
4.100.8860	Deliver receiver control software to users	2004-Jan-01	2			X								
4.100.8865	Deliver FE software req. to computing IPT	2004-Jan-01	2			X								
4.100.8905	Freeze the design of the IF switch/processor	2004-Jan-01	2			X								
4.100.8920	Freeze the design of the FE chassis	2003-Oct-01	2			X								
4.105.8825	Deliver DC bias electronics for cartridge #1	2004-Jan-01	2			X								
4.105.8830	Deliver DC bias electronics for cartridge #8	2004-Jul-01	2				X							
4.105.8850	Deliver the monitor and control module for front-end number one	2004-Mar-01	2			X								
4.105.8855	Deliver the monitor and control module for front-end number eight	2004-Sep-01	2				X							
4.105.8910	Deliver the IF switch/processor for the first front-end	2004-Oct-01	2				X							
4.105.8915	Deliver the IF switch/processor for the eighth front-end	2005-Jul-01	2				X							
4.105.8925	Deliver the FE chassis for receiver #1	2004-Jan-01	2			X								
4.105.8930	Deliver the FE chassis for receiver #8	2004-Jul-01	2				X							
4.145.8935	Band 3 Cartridge #1 delivered	2004-Oct-01	2				X							
4.145.8940	Band 3 Cartridge #8 delivered	2006-Jan-01	2					X						
4.165.8945	Band 6 Cartridge #1 delivered	2004-Oct-01	2				X							
4.165.8950	Band 6 Cartridge #8 delivered	2006-Jan-01	2					X						
4.175.8955	Band 7 Cartridge #1 delivered	2004-Oct-01	2				X							

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
4.175.8960	Band 7 Cartridge #8 delivered	2006-Jan-01	2					X						
4.195.8965	Band 9 Cartridge #1 delivered	2004-Oct-01	2			X								
4.195.8970	Band 9 Cartridge #8 delivered	2006-Jan-01	2					X						
4.210.8795	Delivery of 2 WVR development prototypes	2004-Sep-01	2			X								
4.215.8800	Deliver WVR #1 to OSF	2006-Jan-01	2					X						
4.215.8805	Deliver WVR #8 to OSF	2006-Dec-01	2						X					
4.220.8975	FE Test & Integration centre design ready	2003-Oct-01	2		X									
4.230.8040	Initial Front End Subsystem available at OSF	2005-Dec-31	1				1							
4.230.8980	NA FE Test & Integration centre operational	2004-Oct-01	2			X								
4.230.8985	EU FE Test & Integration centre operational	2004-Oct-01	2			X								
4.230.9000	Deliver Receiver #1 to the ATF	2005-Jul-01	2				X							
4.230.9005	Deliver receiver #2 to OSF/AOS	2005-Oct-03	2				X							
4.230.9010	Deliver receiver #7 to OSF/AOS	2006-Mar-15	2					X						
4.230.9015	Deliver receiver #8 to OSF/AOS	2006-May-01	2					X						
4.240.9025	Definition of FE Service & exchange vehicle requirements	2004-Jan-01	2			X								
4.240.9030	FE Service & exchange vehicle #1 available	2005-Apr-01	2				X							
4.258.40501	Cold multiplier performance verified	2003-Mar-01	3		O									
4.258.8870	LO review	2002-Nov-21	2	X										
4.258.8880	Deliver lab prototype LO chain to each cartridge man.	2003-Jun-30	2	X	X									
4.258.8890	Freeze LO design	2003-Oct-01	2		X									
4.258.8895	Deliver LO chain(s) for cartridge #1	2004-Jan-01	2		X									
4.258.8900	Deliver LO chain(s) for cartridge #8	2005-Jan-01	2				X							
4.105.8856	Deliver the final monitor and control circuitry to each of the receiver builders	2004-Mar-01	2			X								
4.100.8922	Freeze FE Design	2004-Jan-01	2			X								
5.260.50301	Define inventory of modules.	2003-Jan-10	3		O									
5.260.50302	Firm up science requirements and module specifications	TBD	3		O									
5.260.50303	Review need for additional resources to meet schedule	2003-Jan-30	3		O									
5.260.50304	Master Laser Contract signed	2003-Jan-31	3		O									
5.260.50305	Identify impact of systems integration test plan on BE design	TBD	3		O									
5.260.50306	Identify impact of selection of LO photonics design on the BE design	2003-Jul-10	3		O									
5.260.50307	Write Back End ICDs	2003-Aug-31	3		O									
5.260.50308	Complete module designs	2003-Oct-30	3		O									
5.260.50309	Design and develop test fixtures and automated test sets	2003-Oct-30	3		O									
5.260.50310	Complete module and test set construction	2003-Oct-30	3		O									
5.260.50311	Complete module testing	2003-Dec-30	3		O									
5.260.50401	Deliver modules for systems integration	2004-Jan-05	3		O									
5.260.9100	Deliver BE modules for system integration	2004-Jan-01	2		X									
5.260.9104	Contracts for BE Prototypes in Eur	2003-Sep-30	2		X									
5.260.9106	Deliver Back End Production Plan	2004-Sep-01	2			X								
5.260.9120	All BE production contracts placed	2005-Jan-01	2				X							
5.262.9105	Install BE hardware on two ALMA prototype antennas at the ATF	2004-May-01	2			X								
5.262.9110	Complete BE Critical Design Review	2004-Jul-01	2			X								
5.305.8020	Central Back End System Ready to Install at Array Site	2005-Mar-31	1				1							
5.305.8030	First Antenna based Back End Subsystem Ready for Installation at OSF	2005-Nov-01	1				1	1						
5.305.9122	Deliver Back End Assembly, Test, & Verification Plan	2004-Nov-30	2			X								
5.305.9125	All ALMA assembly, test and verification equipment in place	2005-May-01	2				X							
5.305.9130	Deliver BE antenna hardware for first three antennas	2005-Nov-01	2					X						
5.305.9135	Deliver BE central electronics hardware for first three antennas	2005-Nov-01	2					X						
5.305.9140	Deliver BE antenna and central hardware for antennas #4 - 9	2006-Jul-01	2						X					
5.305.9145	Deliver BE antenna and central hardware for antennas #10 - 17	2007-Jan-01	2							X				
5.305.9150	Deliver BE antenna and central hardware for antennas #18 - 37	2008-Jan-01	2								X			

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WBS #	Milestone Name	Due Date	Level	Year												
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		
5.305.9155	Deliver BE antenna and central hardware for antennas #38 -57	2009-Jan-01	2									X				
5.305.9160	Deliver BE antenna and central hardware for antennas #58 - 64	2009-Oct-01	2										X			
6.315.9200	Complete design of pre-production boards for prototype correlator	2002-Dec-30	2	X												
6.315.9205	Begin integrated testing of prototype correlator	2003-Jan-06	2		X											
6.315.60301	Second station motherboard installed	2003-Feb-14	3		O											
6.315.60302	All station PCBs assembled	2003-Feb-14	3		O											
6.315.9208	Correlator ICDs submitted for approval	2003-Jun-13	2		XX											
6.315.60303	Correlator motherboard installed	2003-Feb-24	3		O											
6.315.60304	All correlator PCBs except QCC assembled	2003-Apr-07	3		OO											
6.315.60305	FPDP interface verified	2003-May-26	3		O											
6.315.60306	First end-to-end test	2003-Jul-01	3		OO											
6.315.9210	Hold Critical Design Review	2003-Sep-26	2		XX											
6.315.9215	Pass Critical Design Review	2003-Aug-22	2		XX											
6.315.60307	Prototype correlator ready to ship to ATF	2003-Aug-29	3		O											
6.315.9225	Prototype Correlator shipped to ATF	2003-Dec-15	2		X											
6.315.60308	Hardware documentation Version 1 complete	2003-Dec-15	3		O											
6.320.60309	Begin ordering parts for first quadrant	2003-Jul-23	3		OO											
6.320.9220	Contract signed for Custom Correlator chips	2003-Sep-01	2		X											
6.320.9230	Begin assembly of first quadrant	2003-Sep-01	2		X											
6.320.9235	Begin board testing for first quadrant	2003-Nov-03	2		X											
6.320.60401	First motherboard installed	2004-Jan-15	3		O											
6.320.60402	All station PCBs assembled	2004-Mar-01	3		O											
6.320.60403	All motherboards installed	2004-Mar-01	3		O											
6.320.9240	Begin integrated testing for first quadrant	2004-Apr-01	2			X										
6.320.60404	All correlator PCBs assembled	2004-Apr-15	3			O										
6.320.60405	First end-to-end test	2004-Jul-15	3			O										
6.320.9245	Begin ordering parts for second quadrant	2004-Oct-01	2				X									
6.320.60501	First quadrant ready to ship to Chile	2005-Jan-07	3				O									
6.320.60502	Hardware documentation Version 1 complete	2005-Mar-30	3				O									
6.320.9250	First quadrant shipped to Chile	2005-Jul-31	2					X								
6.320.9255	Begin assembly of second quadrant*	2005-Jan-07	2				X									
6.320.9260	Begin board testing for second quadrant	2005-Mar-01	2				X									
6.320.9265	Begin integrated testing for second quadrant	2005-May-01	2				X									
6.320.9270	Begin ordering parts for third quadrant	2005-Oct-01	2					X								
6.320.9275	Second quadrant shipped to Chile	2006-Jan-07	2						X							
6.320.9280	Begin assembly of third quadrant*	2006-Jan-07	2						X							
6.320.9285	Begin board testing for third quadrant	2006-Mar-01	2						X							
6.320.9290	Begin integrated testing for third quadrant	2006-May-01	2						X							
6.320.9295	Begin ordering parts for fourth quadrant	2006-Oct-01	2							X						
6.320.9300	Third quadrant shipped to Chile	2007-Jan-07	2								X					
6.320.9305	Begin assembly of fourth quadrant*	2007-Jan-07	2								X					
6.320.9310	Begin board testing for fourth quadrant	2007-Mar-01	2								X					
6.320.9315	Begin integrated testing for fourth quadrant	2007-May-01	2								X					
6.320.9320	Fourth quadrant shipped to Chile	2008-Jan-07	2									X				
6.325.9350	Second Generation Correlator Feasibility Study	2002-Mar-27	2	X												
6.325.60310	2GC System Requirements Review Meeting	2003-Jun-08	3		O											
6.325.9355	2GC System Requirements Review	2003-Nov-30	2		X	X										
6.325.9360	2GC Conceptual Design Review	2004-Mar-19	2			X										
6.325.9365	2GC Preliminary Design Review	2005-Feb-28	2				X									
7.340.9400	Computing Subsystem Start (T0)	2002-Jun-01	2	X												
7.340.9405	Internal Design Review (IDR)	2002-Dec-09	2	X												

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
7.340.9410	Preliminary Design Review (PDR)	2003-May-08	2		X									
7.340.9415	Subsystem pre-release (R0)	2003-May-16	2		X									
7.340.9420	Subsystem Critical Design Review 1 (CDR1)	2003-Aug-01	2		X									
7.340.9425	Deliver ALMA Operations Plan, Software Aspects	2004-Jan-01	2			X								
7.340.9430	Subsystem Minor Release 1.1 (R1.1)	2004-Apr-01	2			X								
7.340.9435	Critical Design Review 2 (CDR2)	2004-May-01	2			X								
7.340.9440	Subsystem Minor Release 2.1 (R2.1)	2005-Apr-01	2				X							
7.340.9445	Subsystem Critical Design Review 3 (CDR3)	2005-May-01	2				X							
7.340.9450	Subsystem Minor Release 3.1 (R3.1)	2006-Apr-01	2					X						
7.340.9455	Subsystem Readiness Review (RR)	2006-Jun-01	2					X						
7.340.9460	Subsystem Major Release 4 (R4)	2006-Oct-01	2						X					
7.340.9465	Subsystem Preliminary Acceptance Review (PAR)	2006-Dec-01	2						X					
7.340.9470	Software Agreements, Final Construction Phase	2007-Jun-01	2							X				
7.340.9475	Support Completion (T1)	2007-Jun-01	2							X				
7.340.9480	Computing Preliminary Acceptance (CPA)	2007-Mar-01	2						X					
7.340.9485	Interim science observation	2007-Jun-01	2							X				
7.340.9490	Complete Subsystem Upgrade	2011-Jun-01	2										X	
7.340.9495	Subsystem Major Release 1 (R1)	2003-Oct-01	2		X									
7.340.9500	Subsystem Major Release 2 (R2)	2004-Oct-01	2			X								
7.340.9505	Subsystem Major Release 3 (R3)	2005-Oct-01	2				X							
7.340.9510	Subsystem Minor Release 4.1 (R4.1)	2007-Apr-01	2						X					
7.340.9515	Integration Release 1 (IR1)	2003-Dec-01	2		X									
7.340.9520	Integration Release 2 (IR2)	2004-Dec-01	2			X								
7.340.9525	Integration Release 3 (IR3)	2005-Dec-01	2				X							
7.340.9530	Integration Release 4 (IR4)	2006-Dec-01	2					X						
7.340.9535	Integration Release 4.1(IR4.1)	2007-Jun-01	2						X					
7.340.70301	PDR documents delivered to review panel	2003-Feb-24	3		O									
7.340.70302	PDR meeting held	2003-Mar-20	3		O									
7.340.70303	PDR panel report submitted to JAO	2003-Apr-16	3		O									
7.340.70304	PDR Computing IPT Management Response	2003-May-08	3		O									
7.340.70305	2003-March code checkin	2003-Mar-01	3		O									
7.340.70306	2003-April code checkin	2003-Apr-01	3		O									
7.340.70307	CDR1 Document Set available to Computing IPT	2003-Jun-20	3		O									
7.340.70308	CDR1 Document Set to Reviewers	2003-Jun-20	3		O									
7.340.70309	Subsystem CDR1 meetings completed	2003-Jul-18	3		OO									
7.340.70310	CDR1 review panel reports due to computing IPT	2003-Jul-18	3		OO									
7.340.70311	CDR1 Document Revisions in ALMAEDM	2003-Aug-01	3		O									
7.340.70312	2003-05 Subsystem checkin	2003-May-08	3		O									
7.340.70314	2003-07 checkin	2003-Jul-01	3		O									
7.340.70315	2003-08 checkin	2003-Aug-01	3		O									
7.340.70316	2003-09 checkin	2003-Sep-01	3		O									
7.340.70317	Final FE/M&C ICD comments submitted to FE IPT	2003-Apr-01	3		O									
7.340.70318	Final Antenna/M&C comments submitted to Antenna IPT	2003-Jun-01	3		O									
7.340.70319	Final LO ICD input to FE IPT	2003-Jul-01	3		O									
7.340.70320	Final BE ICD input to BE IPT	2003-Jul-01	3		O									
7.340.70321	All ATF M&C ICDs complete	2003-Aug-01	3		O									
7.340.70322	Software releast to support lab system integration	2003-Dec-01	3		O									
7.340.70323	Prototype correlator software demonstration	2003-Oct-01	3		O									
7.340.70324	Science Data Format discussion document	2003-Jun-01	3		O									
7.340.70401	Provide input to WVR ICD for PDR	2004-Aug-01	3			O								
7.340.70402	Software release to support first fringers at ATF	2004-May-01	3			O								

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
7.340.70403	All M&C ICDs for Chile complete	2004-Sep-01	3			O								
7.340.70404	Science Data Format draft document	2004-Jan-01	3			O								
7.340.70405	Science Data Format reviewed document	2004-Jun-01	3			O								
8.365.80301	80301- Product Assurance Plan - draft	2003-Mar-31	3		O									
8.365.80302	80302- Configuration Management Plan - draft	2003-May-26	3		O									
8.365.9602	System Requirements Review (SRR) - System Requirements Finalized	2003-Sep-01	2		X									
8.365.80305	9602-1 List and outline of all Requirements documents	2003-May-15	3		O									
8.365.80306	9602-2 Environment Requirements - draft	2003-Jul-01	3		O									
8.365.80307	9602-3 Environment Requirements - ready for review	2003-Aug-01	3		O									
8.365.80308	9602-4 Engineering Requirements - Electrical and Electronical -draft	2003-Jul-01	3		O									
8.365.80309	9602-5 Engineering Requirements - Electrical and Electronical -ready for review	2003-Aug-01	3		O									
8.365.80310	9602-6 Engineering Requirements - mechanical and thermal -draft	2003-Jul-01	3		O									
8.365.80311	9602-7 Engineering Requirements - mechanical and thermal -ready for review	2003-Aug-01	3		O									
8.365.80312	9602-8 System Requirements - draft	2003-Jul-01	3		O									
8.365.80313	9602-9 System Requirements - ready for review	2003-Aug-01	3		O									
8.365.80314	9602-10 EMC / RFI requirements - draft	2003-Jul-01	3		O									
8.365.80315	9602-11 EMC / RFI requirements - ready for review	2003-Aug-01	3		O									
8.365.80316	9602-12 All system level ICD requirements - draft	2003-Jul-01	3		O									
8.365.80317	9602-13 All system level ICD requirements - ready for review	2003-Aug-01	3		O									
8.365.80318	9602-14 Requirements Data base, Requirements Tree	2003-Oct-01	3		O									
8.365.9605	ALMA System Design Review	2003-Dec-01	2		X									
8.365.9615	ALMA System CDR	2005-Jul-01	2				X							
8.370.9650	Prototype Integration & Verification Plan (Q4 2003 through Q4 2004) approved for Lab & ATF	2003-Aug-01	2		X									
8.370.80303	9650-1 Prototype Integration Plan - draft - outline and inventory only	2003-Apr-30	3		O									
8.370.80304	9650-2 Prototype Integration Plan - draft	2003-Jun-01	3		O									
8.370.9653	All hardware for Prototype System Lab Integration accepted and delivered	2004-Jan-01	2			X								
8.370.80319	9653-1 Acceptance Review (AR) completed for all items for system prototype integration	2003-Dec-15	3		O									
8.370.9656	AEG Releases Antennas to ALMA System Prototype Integration Group	2004-Apr-01	2			X								
8.370.9659	ALMA prototype electronics and software installed on ATF	2004-May-01	2			X								
8.370.80320	9659-1 ATF Test Readiness Review (TRR)	2004-May-07	3			O								
8.370.9662	First interferometer fringes using prototype antennas at ATF	2004-Sep-01	2			X								
8.370.9665	Discontinue interferometer hardware and software system testing and commissioning	2005-Jan-01	2				X							
8.370.80321	9665-1 ATF Post Test Review (PTR)	2005-Jan-15	3				O							
8.370.9668	Finish testing of ALMA prototype and production hardware / software on ATF	2006-Jul-01	2					X						
8.370.8005	Start Antenna Evaluation at ALMA Test Facility	2003-Mar-22	1	11										
8.370.9700	NA Prototype Holography Complete	2003-Jul-03	3		O									
8.370.9703	NA Prototype Optical Tracking and Pointing Tests Complete	2003-Sep-15	3		O									
8.370.9706	NA Prototype Radiometric Testing and Evaluation Complete	2004-Jan-20	3			O								
8.370.9709	EU Prototype Holography Complete	2003-Nov-25	3		O									
8.370.9712	EU Prototype Optical Tracking and Pointing Tests Complete	2004-Jan-05	3		O									
8.370.9715	EU Prototype Radiometric Testing and Evaluation Complete	2004-Mar-16	3		O									
8.370.9718	NA Prototype Evaluation Report	2004-Feb-16	2			X								
8.370.9721	EU Prototype Evaluation Report	2004-Mar-31	2			X								
8.375.9750	ALMA Integration & Verification Plan - Q1 2005 through Q4 2007 for OSF and AOS	2004-Jan-01	2			X								
8.375.9753	Establish Integration office at OSF	2005-Feb-15	2				X							
8.375.9756	Integration team and infrastructure ready at OSF.	2005-Sep-01	2					X						
8.375.9759	Initial central electronics and computing - integrated, tested and accepted at OSF	2005-Nov-15	2					X						
8.375.9762	Initial antenna electronics and computing - integrated, tested and accepted at OSF	2005-Nov-15	2					X						
8.375.9765	First fully outfitted antenna integrated and accepted at OSF	2006-Feb-15	2					X						
8.375.9768	First fully outfitted antenna integrated and accepted at AOS	2006-Apr-01	2					X						
8.375.9771	Phase 2 ALMA Integration and Verification Plan Q1 2008 and beyond	2006-Jul-01	2					X						

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WBS #	Milestone Name	Due Date	Level	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
8.375.9774	Three antenna array integrated & functioning at AOS	2006-Aug-01	2					X						
9.380.8045	Start Early Science Operations	2007-Sep-30	1						1					
9.380.8055	Start of full Science Operations	2012-Mar-31	1											1
9.380.9800	Plan for compact and intermediate configurations submitted	2002-Nov-27	2	X										
9.380.9805	Review of calibration requirements with science examples complete	2003-Feb-28	2		X									
9.380.9812	Document on how calibration reqs flow down to instrumental specs	2003-Jun-30	2		X									
9.380.9815	Plan for Y+ configuration submitted	2003-Jun-30	2		X									
9.380.98151	Investigation of Logic of Antenna Motion	2003-May-31	3		O									
9.380.98152	First revised configuration (pad position) plan submitted	2003-Apr-09	3		O									
9.380.9820	Calibration strategy submitted	2003-Sep-30	2		X									
9.380.9825	Science aspects of operations plan complete	2003-Dec-31	2		X									
9.380.9830	Plan for early science configurations complete	2004-Jun-30	2			X								
9.380.98301	Draft plan for Early Science configurations	2004-Feb-29	3			O								
9.380.9835	Report WVR strategy / implementation / operations	2004-Sep-30	2			X								
9.380.9840	Review of tests of calibration strategies on prototype interferometer complete	2004-Dec-31	2			X								
9.380.9843	Review of tests of calibration strategies on ATF interferometer	2005-May-30	2				X							
9.380.9845	Science verification plan for commissioning submitted	2005-Jun-30	2				X							
9.380.98451	Science verification plan for commissioning drafted	2003-Dec-31	3		O									
9.380.98452	Science verification draft for commissioning revised	2004-Jun-30	3			O								
9.380.9850	Science verification of ALMA early science array Bands 3, 6, & 7 complete	2007-Jul-31	2						X					
9.380.98501	Science verification of ALMA early science array Bands 3, 6, & 7 begins	2007-Apr-30	3					O						
9.380.9855	Science verification of ALMA Band 9 complete	2008-Sep-30	2							X				
9.380.98551	Science verification of ALMA Band 9 begins	2008-Jun-30	3						O					
9.380.9860	Science verification of ALMA imaging quality	2009-Dec-31	2								X			
9.380.9865	Final Science verification complete array	2011-Dec-31	2										X	
9.380.9870	Definition of site characterization instrumentation for ALMA operations	2006-Jan-31	2					X						
9.380.98701	Uniform integration of NA and EU data.	2003-Apr-30	3		O									
9.380.98702	Description of current site characterization instrumentation.	2003-Jun-30	3		O									
9.380.98703	Radio sonde data analysis written.	2003-Jul-31	3		O									
9.380.98704	Report on analysis of high precision hygrometer measurements.	2003-Jul-31	3		O									
9.380.98705	Report on phase correction analysis	2003-Jul-31	3		O									
9.380.98706	Report on height of turbulent layer	2003-Dec-31	3		O									
9.380.98707	Report on accuracy of mesoscale atmosphere models	2003-Jul-31	3		O									
9.380.98708	Report on RFI environment at Chajnantor	2003-Jun-30	3		O									
9.380.98051	Draft of calibration requirements document	2002-Dec-31	3	O										
9.380.98121	ATM software library available	2003-Mar-20	3		O									
9.380.98122	Draft specifications for calibration devices	2003-Apr-30	3		O									
9.380.98201	Draft of bandpass calibration plan	2003-Mar-30	3		O									
9.380.98202	Draft of phase calibration plan	2003-Apr-15	3		O									
9.380.98203	Draft of amplitude calibration plan	2003-May-31	3		O									
9.380.98204	Review of SSR plan for phase calibration techniques	2003-May-31	3		O									
9.380.98205	Draft of delay calibration plan	2003-Apr-30	3		O									
9.380.98206	Draft of antenna location determination plan	2003-Mar-31	3		O									
9.380.98207	Draft of antenna global pointing model determination plan	2003-Mar-30	3		O									
9.380.98208	Draft of reference pointing and focus calibration plans	2003-Mar-30	3		O									
9.380.98209	Draft of polarization calibration plan	2003-Jun-30	3		O									
9.380.98210	Draft of operation model for calibration	2003-Jun-30	3		O									
9.380.98211	Revised bandpass calibration plan	2003-Jun-30	3		O									
9.380.98212	Revised phase calibration plan	2003-Jun-30	3		O									
9.380.98213	Revised amplitude calibration plan	2003-Jun-30	3		O									
9.380.98214	Revised antenna location determination plan	2003-Jun-30	3		O									

ALMA Milestone Summary (Version: 2003jul28a)

Legend: Level 1: 1 Level 2: X Level 3: o (Original dates in gray)

WBS #	Milestone Name	Due Date	Level													
				2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012		
9.380.98215	Revised delay calibration plan	2003-Jun-30	3		o											
9.380.98216	Revised antenna global pointing model determination plan	2003-Jun-30	3		o											
9.380.98217	Revised reference pointing and focus calibration plan	2003-Jun-30	3		o											
9.380.98218	Revised polarization calibration plan	2003-Jul-31	3		o											
9.380.98219	Complete draft report on calibration strategy ready for review	2003-Jul-31	3		o											
9.380.98220	Test plan for amplitude calibration devices on ATF	2003-Sep-30	3		o											
9.380.98221	First fringes on ATF interferometer	2004-Aug-31	3			o										
9.380.98351	Draft of WVR technical aspects document	2003-Mar-30	3		o											
9.380.98352	Report on feasibility and usefulness of WVRs on ATF interferometer	2003-Jun-30	3		o											
9.380.98353	Draft WVR software implementation plan	2004-Mar-30	3			o										
9.380.98401	Prototype antenna motion tests complete	2004-Jun-30	3			o										
9.380.98402	Report on prototype antenna pointing in varying wind conditions	2004-Jun-30	3			o										
9.380.98431	Tests of dynamic scheduling on interferometer at ATF.	2005-Jan-31	3				o									
9.380.98432	Plan for interferometry tests on ATF complete	2004-Mar-31	3			o										